

RCRA FACILITY INVESTIGATION  
PHASE I WORKPLAN  
**RECEIVED**

Safety-Kleen Corporation MAY 04 1993  
Chicago Recycle Center  
Cook County, Illinois

IEPA - BOL  
PERMIT SECTION

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## **1. Introduction**

This workplan has been prepared by LTI, Limno-Tech, Inc. on behalf of Safety-Kleen Corp. (Safety-Kleen) to satisfy requirements of Section IV.B of the RCRA Hazardous Waste Management Part B permit (the permit) for the Safety-Kleen Chicago Recycle Center (CRC). This workplan presents the proposed investigation tasks for the Phase I RCRA Facility Investigation (RFI) to be conducted at the CRC. This workplan is being submitted to the Illinois Environmental Protection Agency (IEPA) for review, comment and approval.

Section IV.B of the RCRA Hazardous Waste Management Part B permit requires that a Phase I RFI be conducted for two SWMU areas at the CRC, including: 1) the area north and west of the Container Storage Area #1; and 2) the area south of Tank Farms #2 and #3. These SWMU areas were identified as areas of concern in the 1990 RFA and therefore a Phase I RFI has been required as the first step in the corrective action process under the permit.

Attachment G to the permit establishes the requirements for conducting the RFI. The scope of the RFI as specified in the permit is divided into two phases. The purpose of Phase I is to determine whether or not any releases have occurred from the identified SWMUs. If the Phase I results indicate that a release has occurred, Phase II investigations may be required to determine the nature, extent, and distribution of the hazardous waste constituents. Based upon the Phase II results, IEPA may then require the implementation of interim corrective actions.

The Phase I RFI scope of work proposed herein provides for collection of data beyond the scope required by the permit. This approach is being proposed because investigations in this area have been conducted related to other site activities. Three investigations were conducted by Safety-Kleen in the vicinity of the SWMU areas in 1991 during the closure of tanks contained in Tank Farm No. 3 (tanks T190-T193). The data generated during these investigations can be used to help guide and supplement data collected as part of the RFI. Similarly, the data generated during the RFI will likely be useful in evaluations related to the closure activities. In previous communications with IEPA, Safety-Kleen and the Agency have indicated a desire to coordinate the closure and RFI activities to maximize the utility of the data generated and to minimize duplicative efforts.

Elements of this workplan have been designed to provide data regarding the nature, extent, and distribution of impacts in addition to determining whether or not a release has occurred. Therefore, the scope of this Workplan is intended to satisfy the objectives of a Phase I RFI, as well as provide preliminary information related to the Phase II objectives.

The workplan presents background information for the CRC, defines the proposed scope of work and describes the proposed investigative tasks. Associated plans attached to this workplan specify procedures that will be employed for data collection and management (Data Management Plan), quality assurance/quality control (Quality Assurance Project Plan), and personnel health and safety (Health and Safety Plan). The

scope and content of the workplan documents have been structured to be consistent with and meet the requirements contained in Attachment G of the Part B Permit for the CRC.

## **2. Facility Background**

The Chicago Recycle Center (CRC) is located within the city limits of Chicago, Cook County, Illinois between 42nd Street and 43rd Street. A regional USGS topographic map is showing Figure 1 and a site topographic map for the CRC is shown in Figure 2. As evident on the maps, the CRC occupies approximately eight acres of land, about 1000 feet east of Ashland Avenue. This area of Chicago, known as the Chicago Stockyards, has a long history of industrial use and the present land use is characterized as urban industrial.

### **2.1 Present Facility Operations**

The CRC is an organic chemicals reclamation and recycling facility permitted to treat and store hazardous wastes under a RCRA Hazardous Waste Management Part B permit (effective November 4, 1992). The permit consists of a RCRA permit issued by IEPA under Title 35 of the State of Illinois Rules and Regulations and a Hazardous Waste Management Permit issued by USEPA under the Hazardous and Solid Waste Amendments of 1984 to RCRA (HSWA).

The CRC accepts organic chemicals and solvent wastes from industrial and commercial facilities. Reclamation and recycling operations involve either regeneration of the spent solvent or blending and processing of the material for use as a hazardous waste fuel. Wastes accepted at the facility include organic acids, chlorinated and fluorinated hydrocarbons, amines, alcohols, aliphatic and aromatic compounds, waste oils, and paint wastes. The facility serves a variety of industries including chemical manufacturers, paint manufacturers, pharmaceutical manufacturers, electronics manufacturers, maintenance shops, metal fabricators, and foundries. Processes utilized in the reclamation of used solvents, solvent mixtures, and other solvent containing wastes include neutralization, distillation, fractionation, liquid-liquid extraction, and drying.

Tank farms and container storage areas are used to manage or store a variety of compounds at the CRC. The list of materials managed or stored in a particular unit may vary from day to day. However, a representative list of compounds managed at these units includes: cyclopentane, dimethyl acetamide, ethylene glycol, gamma butyrolactone, isopropyl alcohol, methylene chloride, nitrogen, n-methyl pyrrolidinone, sodium hydroxide, sulfolane, tetrahydrofuran, toluene, 1,1,1-trichloroethane, and trichlorotrifluoroethane.

Hazardous wastes are received at the CRC in containers via trucks. All containers are stored in Container Storage Area No. 1 (see Figure 3). Container Storage Area No. 1 is constructed with secondary containment for spill and leak control, and has a maximum hazardous waste storage capacity of 108,900 gallons. The wastes that are permitted to be stored in Container Storage Area No. 1 are listed in Attachment A of the RCRA Part B permit. Other container storage areas are used for the storage of product.

There are five existing tank farms at the CRC, originally containing 82 above-ground tanks, 14 of which have been removed. Of the 68 remaining tanks, 59 are subject to RCRA regulations. In addition, four more tank farms have been proposed with 27 additional tanks.

## 2.2 Historical Facility Operations

The use of the CRC property prior to 1969 is unknown but likely associated with livestock processing. Between 1969 and 1985, the site was owned and operated by Custom Organics for industrial chemical processing. Safety-Kleen acquired the site in 1985 for its current use as a recycling center.

Between 1969 and 1985, when the facility was owned and operated by Custom Organics, only Tank Farm No. 3 was in existence. No records are available for the utilization of the tanks. According to the Safety-Kleen CRC manager, who was employed by Custom Organics between 1981 and 1985, the tanks were used for a variety of purposes, including the storage of hazardous waste, in-process material, product, and wastewater. A partial list of chemicals handled by Custom Organics included: dimethyl acetanide; gamma butyrolactone; methylene chloride; n-methyl pyrrolidone; toluene; 1,1,1-trichloroethane; and trichlorotrifluoroethane.

After Safety-Kleen purchased the facility in 1985, the present tank farms and container storage areas were constructed. The use of Tanks Nos. T190 through T193 in Tank Farm No. 3 for the storage of hazardous waste, in-process material, and product was discontinued. From 1985 to 1987 these tanks were used only for wastewater storage. In 1987, Safety-Kleen stopped using them altogether, and in 1991 they were removed.

## 2.3 Description of the SWMUs

Section IV.B of the RCRA Hazardous Waste Management Part B permit requires that the Phase I RFI be conducted for two SWMU areas at the CRC, including: 1) the area north and west of the Container Storage Area #1; and 2) the area south of Tank Farms #2 and #3. The extent of these SWMU areas are shown in Figure 3 and do not presently contain any building structures or fixed equipment.

The SWMUs have reportedly been in their present state (without building or equipment structures) since at least 1969. Subsurface obstructions encountered in the SWMUs during previous soils investigations were characterized as old building foundations and therefore suggest that buildings were once present in portions of the SWMUs. As mentioned above, the CRC is in the Chicago Stockyard area, and likely was the site for historical operations related to livestock processing.

No materials are presently managed or stored at the two SWMUs. However, historical spills have been reported for the SWMUs. IEPA Land Division files indicate that open drums containing waste material and rain water were observed in storage in the area south of Tank Farm No. 3 on September 9, 1981, prior to Safety-Kleen ownership. A spill of semi-solid waste material was observed in this area on October 10, 1982, also prior to ownership by Safety-Kleen. Safety-Kleen documented a spill of 20 gallons of freon which occurred on July 22, 1987, in the area on the west side of Container Storage Area No. 1. The area was uncontained, and impacted soil was excavated at that time.

Other than the remediation of the 1987 Freon spill, no interim corrective action measures have been implemented in the SWMU areas. For areas adjacent to the SWMU areas, specifically Tank Farm #3, closure activities have been conducted. Between April and July, 1991, Tank Nos. 190 through 193 in Tank Farm #3 were removed from service and closed by Safety-Kleen. According to the closure report (Canonie, 1991) the four above-ground steel tanks were emptied, cleaned, and decontaminated, then the tanks were removed and sold as scrap to a private scrap dealer. The concrete slabs on which the four tanks had rested were removed, as were the northern and western walls of the concrete containment dike. Additional closure activities may be conducted in this area in the future. Because Tank Farm #3 is adjacent to the SWMU areas, the future closure activities may also serve as interim measures for portions of the SWMUs.

## **2.4 Description of Surrounding Areas**

As evident in Figure 2, land use in the area surrounding the CRC is urban commercial/industrial. Immediately to the east of the facility are Rosebud (manufacturers of boxes and containers) and an Illinois Air Emission Station. The Ashland Cold Storage warehouse is located immediately to the west of the facility. Immediately to the south of the facility is West 43rd Street and Cameo Containers.

No significant surface features such as lakes, ponds, wetlands, streams, depressions, or other features which would affect the migration routes of potentially released materials exist within a 1500 foot radius of the facility (see Figure 2). A sewer exists in the alley immediately to the west of the SWMUs which may influence local groundwater flow patterns. Data will be collected and evaluated as part of the Phase I RFI to provide an indication of the influence of this sewer on the local hydrogeology. There are no known withdrawal wells in the 1500 foot radius around the CRC.

According to the RFA, the CRC is not located within any 100 year floodplain. Since the facility does not conduct any on-site disposal of waste, it is not subject to floodplain standards for disposal facilities. The nearest surface water to the facility is the South Branch of the Chicago River, located approximately 1.5 miles to the north.

Due to the exclusively urban/industrialized nature of the area in the vicinity of the CRC, there are no natural environmental systems, such as surface water bodies or wetlands, which would be potentially threatened by a release from the SWMU areas. Similarly, residential exposure to potential releases in the area is minimal. Nearby human populations potentially exposed to potential releases from the SWMU areas would be limited to workers at the CRC and the adjacent industries. The operational portion of the site is completely fenced.

## **3. Nature and Extent of Impacts**

### **3.1 Possible Source Areas of Impacts**

Possible sources of subsurface impacts by hazardous constituents in the vicinity of the SWMU areas include upgradient off-site sources and on-site sources. Possible off-site sources would include leaks or spills from operations at another off-site facility,

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upgradient of the CRC. Off-site source(s) would most likely be located to the west of the CRC, since groundwater moves across the site in a west to east direction. There is presently no information to assess the presence or location of off-site sources, but elements of the RFI workplan are designed to provide this information (up-gradient monitoring wells).

Possible on-site sources include accidental spills during historical operations or leaks from equipment over a period of time. Custom Organics operated the facility for many years before the passage of RCRA, and no records were kept for spills that may have occurred. Leaks may have occurred from tanks, pipes, fittings, or storage containers at the facility, or they may have occurred during normal filling operations from nozzles and pipe ends. There is no documentation or direct evidence to support these possibilities.

Since Safety-Kleen purchased the facility, no releases have been reported, other than the 1987 freon spill discussed above. Therefore, no evidence suggests that recent spills are likely sources. Possible releases from Tank Farm Nos. 2 and 3 may be a source impacting the SWMU area. Data collected in 1991 during the closure activities for Tank Farm #3 indicate that organic compounds may have been released from the tanks during the history of their operation. The quantities released from the tanks, if any, are unknown.

### 3.2 Site Characteristics and Extent of Impacts

Existing information on the site geology, hydrogeology and degree and extent of impacts at the CRC has been obtained from three separate sampling events conducted in association with the closure of four tanks (Tank Nos. 190 through 193) at Tank Farm No. 3 in 1991. These sampling events included soil sampling in February 1991, a soil gas survey and temporary well sampling in May 1991, and soil and groundwater sampling in October 1991 (Canonie, 1991). These reports were previously submitted to the IEPA in November and December, 1991. These studies provide preliminary information regarding the site characteristics and extent of impacts. This information will be supplemented by the data obtained during the proposed Phase I RFI.

#### 3.2.1 *Geology and Hydrogeology*

According to the previous investigations (Canonie 1991) the geology of the site consists of crushed limestone and concrete surfacing material underlain by a 1 to 6 foot thick layer of miscellaneous fill (former concrete foundations, dolomite flagstones, sand, gravel, and crushed brick debris). Below the fill is a saturated soft brownish grey plastic silt layer extending to a depth of approximately 10 to 12 feet. The silty zone was characterized as having a shallow water table, and contains an apparently continuous black silt seam. The silt layer overlays and gradually transforms to an apparently massive and dense dry brown grey clay unit which according to regional drillers logs extends to the limestone bedrock at an approximate depth of 50 feet. The clay may act as an impermeable barrier to the downward movement of water and chemicals.

Groundwater that has been sampled at the site is a shallow apparently unconfined saturated zone within the fill and silty clay units. The groundwater apparently flows west to east with a gradient of 0.036 ft/ft based upon the existing static level data. The groundwater flow directions and gradients have been reported to be strongly influenced by





local features such as water collection sumps located around the recycling center and sunken truck loading dock.

### 3.2.2 Extent and Distribution of Impacts

The closure investigations indicated the presence of organic chemicals in the soil and groundwater in and around Tank Farm No. 3. A large portion of the area investigated during closure activities overlaps with the SWMU areas and therefore provides data that may be useful in the RFI. In previous communications with the IEPA, Safety-Kleen and the IEPA have indicated a desire to coordinate closure and corrective action activities, to avoid duplicative efforts. The existing closure related data can be used to guide and supplement the RFI, and similarly, data generated during the RFI may be useful for evaluation of closure activities. The data obtained from the three closure investigations are summarized below.

#### 3.2.2.1 Pre-Tank Closure Investigation

In February, 1991, a pre-closure investigation was conducted in association with the closure of four above-ground storage tanks (Nos. T190-T193) at Tank Farm No. 3, as required by the closure plan for the tanks. Prior to removal of the tanks, soil samples were taken at eight locations within the concrete containment structure. The containment structure was built with each of the four tanks in its own cell, separated from the adjacent tanks by a concrete wall. Two samples were taken from each cell. The construction of the containment structure was such that the floor and the walls were not continuous, leaving a 1 - 2 foot space of exposed earth around the floors. Soil samples were collected from these areas at ground surface and at two feet below ground surface. Sample locations are shown in Figure 5. The laboratory analytical results for the samples are presented in Table 1. The results indicate impacts from methylene chloride, 1,1,1-trichloroethane (TCA), trichloroethene (TCE), tetrachloroethene (PCE), toluene, freon 113, pyridine, 1-methyl-2-pyrrolidinone, and methyl-pyridine isomer.

The surficial soils data indicate that releases organic chemicals may have occurred from Tank Nos. T-190, T-191, and T-192. Each cell containing the individual tanks was contained by concrete walls keyed into subsurface foundations. Surficial migration of constituents between cells was therefore likely minimal. As such, elevated chemical concentrations identified in surficial soils in a particular cell would likely be attributable to releases from the tank contained within that cell. For example, toluene was measured at concentration 12,000 mg/kg in surficial soils in the former cell for Tank No. T-190, which indicates that toluene may have been released from T-190. Similarly, based on the surficial soils data, Tank No. T-190 appears to be the release location for Trichloroethene; Tank No. T-191 appears to be the release location for toluene, methylene chloride and methyl-pyridine isomer; and Tank No. T-192 may have been the release location for trichloroethane, tetrachloroethene, and freon. Since no samples were obtained from the soil upgradient to Tank Farm No. 3, however, it cannot be demonstrated conclusively that these tanks are the release sources.

#### 3.2.2.2 Post-Tank Removal Investigation



In May, 1991, following the removal of the four above-ground tanks, a post-tank removal investigation was conducted (Canonie 1991). Four temporary well points (P1-P4) were installed to sample groundwater and 15 soil samples were collected and screened for select volatile organic chemicals. The well points and soil sampling points and were located in and around Tank Farm No. 3 at the locations shown in Figure 6.

The groundwater sampling results are provided in Table 2. In groundwater samples collected from P1, methylene chloride was measured at a concentration of 9.5 mg/l and toluene was measured at a concentration of 470 mg/l. Relatively low concentrations (0.002 mg/l - 0.096 mg/l) of other purgeable halocarbons were measured in P3 and P4. Chloroethane, methylene chloride, 1,1-dichloroethane, 1,2-dichloroethene, and trichloroethene were measured in both P3 and P4 (see Table 2). In addition, 1,1,1-trichloroethane was measured in the sample from P4, and chloroform was measured in the sample for P3. The laboratory report for the groundwater sample for P2 indicated the presence of an unidentified peak on the chromatogram which masked some of the other compounds. Those masked compounds may have been present at detectable levels at location P2, but their chromatogram peaks were obscured.

There appears to be significant dissimilarity between the constituents and concentrations of compounds detected at P1 and those detected at P3 and P4. This might indicate that the chlorinated compounds detected at P3 and P4 are the result of a different release from that responsible for the groundwater impacts detected at P1. In addition, the location of P3 is distant from and cross-gradient to the tank area, at what appears to be the most up-gradient extent of the property. This may indicate the presence of up-gradient off-site sources.

The headspace in the soil samples was screened for trichloroethene (TCE), tetrachloroethene (PCE), and toluene (see Table 3). Toluene was detected in 13 of the soil headspace samples, TCE was detected in 11 samples, and PCE was detected in only one sample. The highest soil headspace concentrations were observed in the samples collected in the immediate vicinity of Tank Farm No. 3, with concentrations decreasing with radial distance from the tank farm. PCE was detected at only one location at low levels in the immediate vicinity of the tank farm.

### *3.2.2.3 Supplemental Investigation*

In order to further identify the extent of impacted soil and groundwater discovered during the previous investigations, soil borings were completed and groundwater monitoring wells were installed in October, 1991 (Canonie, 1991). Soil samples were obtained from ten locations around Tank Farm No. 3, as shown in Figure 7. The soil borings were generally extended to a depth of 10 to 12 feet below ground surface. One boring (B4) was drilled and sampled to a depth of 20 feet. The borings were logged and samples were collected at two foot intervals. At the completion of the soil sampling, monitoring wells MW-1, MW-2, and MW-3 were installed at the locations shown on Figure 7. The five foot well screens were installed with the bottom of the screen set at a depth of approximately 10 ft. Several successive attempts were made to install a fourth monitoring well, but subsurface obstructions (possibly old building foundations) precluded successful installation of the well.

The soil samples collected were screened with a portable organic vapor analyzer (OVA) immediately upon opening the split spoon sampler. At a minimum, those samples from each borehole with the highest and lowest OVA readings were sent to the laboratory for analysis. In total, 29 soil samples were analyzed for a variety of volatile and semi-volatile compounds. The analytical results for these soil samples are presented in Table 4 (a & b). The results of the soil analyses indicate detectable concentrations of toluene, trichlorotrifluoroethane, 1,1,1-trichloroethane (TCA), TCE, tetrahydrofuran, PCE, pyridine, b-picoline, n,n-dimethylacetamide, and 1-methyl-2-pyrrolidinone. Acetone was also detected in the samples, but since it was detected in the blanks as well, the results may be attributable to laboratory contamination and are inconclusive. The highest concentrations of all compounds, with the exception of tetrahydrofuran, were detected at B5, which is immediately downgradient of Tank Farm No.3. Consistent with the observation from the previous investigation, the chemical concentrations generally decreased with radial distance from Tank Farm No. 3.

Groundwater samples collected from MW-1, MW-2, and MW-3 indicated the presence of volatile and semivolatile compounds including toluene, trichlorofluoromethane, 1,1,1 trichloroethane, trichloroethene, tetrahydrofuran, tetrachloroethene, pyridine, B-picoline, dimethylacetamide and 1-methyl-2-pyrrolidinone (Table 5). With the exception of tetrahydrofuran and acetone, all compounds tested for were detected at the highest concentrations at MW-2, at the north end of Tank Farm No. 3. The highest concentrations of acetone and tetrahydrofuran, which were not detected in the sample from MW-2, were found at MW-3, northeast of the tank farm. Only relatively low concentrations of all compounds were detected at MW-1, located forty feet east of the tank farm.

### 3.3 Potential Migration Pathways and Impacts on Human Health and the Environment

The potential migration pathways for possible impacts identified in the SWMU areas are generally limited to migration through the groundwater and air. As discussed above, the shallow groundwater at the site is apparently impacted with organic chemicals. These chemicals could be migrating horizontally from west to east across the site in the direction of groundwater flow or vertically downward in the saturated zone. However, no known water supply wells presently exist within a 1000 foot radius of the SWMU areas. In addition, it appears that the groundwater impacts are limited to the shallow saturated zone which would likely not be suitable as a drinking water source. Therefore, the immediate threats to human health or the environment through this migration route are likely minimal. The current information is not sufficient to quantitatively evaluate the extent and rate of migration through the groundwater and potential impacts to human health and the environment. Work elements proposed in the Phase I RFI workplan are designed to provide information to help quantify these factors.

It is also possible that chemicals in the soils and groundwater of the SWMU area could migrate from the SWMU area through air via volatilization or associated with entrained dust particles. However it is expected that this route of migration is relatively minor and will not pose significant threats to human health or the environment. A screening level estimate of the possible impacts of volatilization from the SWMU area is presented in Section 5.2.6, and indicates minimal relative impacts via this route.

Other potential exposure routes include ingestion and dermal contact with impacted surficial soils. However, the entire Safety-Kleen CRC is secured by a perimeter fence, preventing access by non authorized employees. Therefore, the potentially exposed population is limited Safety-Kleen personnel. It is likely that exposure to the impacted soils through ingestion and direct contact is minimal.

#### **4. Administrative Outline and Project Management Plan**

##### **4.1 Objectives**

According to the permit requirements, the objective of a Phase I RFI is to determine whether or not releases have occurred from specified SWMUs. Building upon the data that have been generated as part the closure related investigations described in Section 3, it is proposed that the objectives of the Phase I workplan for the two SWMU areas at the CRC be expanded to provide preliminary information regarding the extent and distribution of impacts at the SWMU areas.

##### **4.2 Technical Task Outline**

The technical tasks proposed herein are designed to provide information regarding the vertical extent of impacts, the upgradient and downgradient horizontal extent of impacts, and further characterization of the site geology and hydrogeology. Specifically, five shallow soil borings are proposed to provide information regarding the vertical and horizontal extent of impacts. One deep boring (extending to bedrock) is proposed to better characterize the site geology. Two shallow monitoring wells are proposed to provide information to determine whether or not a release has occurred and/or to determine the horizontal upgradient extent of groundwater impacts. Three shallow down-gradient monitoring wells are proposed to provide information for determining the groundwater depths, flow directions and downgradient extent of groundwater impacts. Finally, laboratory permeability tests and in-situ hydraulic conductivity tests are proposed to provide information related to the rate of groundwater flow at the site.

The specific sampling, laboratory, and quality assurance procedures that will be employed are presented in the Quality Assurance Project Plan (QAPP) attached to this Workplan. Data management and record keeping procedures are presented in the attached Data Management Plan. All on-site work will be performed in a careful and safe manner in accordance with the attached Health and Safety Plan (HASP).

As described below, the Phase I RFI is proposed to be completed within 16 months of approval of the workplan. Upon project completion, the Phase I RFI report will be submitted to IEPA for review as required by the permit. In addition to the Phase I report, quarterly progress reports will be submitted to the IEPA as required by the permit.

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#### 4.3 Project Management Plan

##### 4.3.1 Management Approach and Project Personnel

The Phase I RFI workplan will be conducted on behalf of Safety-Kleen Corp. by LTI, Limno-Tech, Inc. (LTI) of Ann Arbor, MI. LTI will maintain the oversee, manage, and conduct the technical aspects of the RFI. The analytical laboratory services for this project will be provided by GTEL of Wichita, Kansas. When the Workplan is approved, bids will be solicited from qualified drilling contractors for this project. Environmental Drilling and Contracting of Holland, MI, and Fox Drilling of Itasca, Illinois will be included on the driller bidding list.

LTI will perform the field investigations; compile, review, and evaluate the RFI data, provide QA/QC review and oversight, and prepare the RFI report. The roles and responsibilities of the LTI personnel that will work on this project are listed below and are discussed in Section 2 of the QAPP. The staff qualifications are summarized in Table 6. Complete resumes for all project staff are on file and available upon request.

ROLE	PERSONNEL	GENERAL RESPONSIBILITIES
Project Administrator	Paul L. Freedman	General oversight
Project Manager	Gregory W. Peterson	Project management; Review/approval of all work products; Direct all field, quality assurance, data evaluation, and reporting activities
Project Engineer/Scientist	Scott B. Bell Robert J. Betz Joyce S. Dunkin Catherine A. Whiting Jim Richards	Supervise all field sampling, quality assurance, data evaluation, and reporting activities
Assistant Project Engineer/Scientist	Jing Chen Jonathan B. Farr Brian D. Lord John T. Peterson	Field and technical support

The qualifications of GTEL and their personnel is provided in Appendix K of the QAPP. The project and quality assurance managers for this project at GTEL will be Martha Ward and John Sattler, respectively.

#### *4.3.2 Project Schedule*

The proposed Phase I RFI schedule is graphically presented in Figure 9. Under this proposed schedule, the initial Phase I field work will be completed within 60 days of workplan approval. However, it is proposed as part of this workplan that groundwater samples be collected from the wells quarterly for one year to provide an adequate representation of the seasonal conditions. Laboratory analysis will be completed within 30 days of the final quarterly event. The QA/QC review, data reduction, evaluation, and reporting will be completed 120 days after receipt of the laboratory results for the fourth quarterly sampling event. The Phase I RFI schedule is subject to expansion due to delays caused by factors beyond the control of LTI or Safety-Kleen. Examples of such factors include inclement weather, access restrictions, or delays in obtaining access approvals for off-site sampling locations

#### *4.3.3 Project Budget*

A spreadsheet presenting cost estimates for the proposed Phase I RFI is presented in Table 7. The costs provided in the table are estimates only and are subject to change. Formal bids will be solicited from the subcontractors after the workplan is approved.

### **5. Work Plan Investigation Elements**

#### **5.1 Sampling Plan**

Soil and groundwater samples will be collected to demonstrate whether or not a release has occurred and to provide preliminary data for characterization of the nature, extent, and distribution of impacts in the vicinity of the SWMU areas. Five shallow soil borings are proposed from which a minimum of two discrete samples will be collected for laboratory analysis. The soil samples will be collected to better characterize the horizontal and vertical extent of possible impacts at the SWMU areas. One deep boring (extending to bedrock) will be sampled to better characterize the site geology. Five additional monitoring wells will be installed and groundwater samples will be collected for laboratory analyses. Static water elevations will be measured in the new and existing wells to better characterize the groundwater elevations and flow directions. In-situ hydraulic conductivity tests will be performed in the new wells to better characterize the rate of groundwater and chemical migration. Laboratory permeability tests will be performed on soil samples collected from the clay unit underlying the silt and fill material to characterize the potential for downward vertical flow through this unit.

The permit requires that the Phase I sampling plan include provisions for the sampling and analysis of all hazardous wastes and hazardous constituents, either known or suspected to have been disposed treated or stored in the specified SWMU areas. No hazardous wastes or constituents are presently managed or stored in the SWMU areas and no chemical specific information is available regarding historical disposal, treatment or storage in the SWMU areas. However, based upon the list of materials handled at the CRC and compounds detected in soils and groundwater from previous investigations in the vicinity of the SWMU areas, it is proposed that the soil and groundwater samples be analyzed for the following volatile and semi-volatile parameters:

Volatiles (SW-846, Method 8240)

•	Chloroform	•	Chloroethane
•	1,1-Dichloroethane	•	1,2-Dichloroethene
(total)			
•	Methylene chloride	•	Tetrachloroethene
•	1,1,1-Trichloroethane	•	Trichloroethene
•	Trichlorotrifluoroethane	•	Tetrahydrofuran
•	Toluene		

Semivolatiles (SW-846, Method 8270)

- 1-Methyl-2-pyrrolidinone
- B - Picoline
- Pyridine

The laboratory analyses will be conducted in accordance with the procedures presented in the QAPP (see Section 7 of the QAPP).

## 5.2 Technical Tasks

The permit requires that sampling plans include groundwater, soils, sediment, surface water, and air sampling. For the CRC SWMU areas, only groundwater and soils sampling is proposed. There are no sediments or surface waters in the vicinity of the SWMU area and therefore the requirements are not applicable. In addition, as discussed below, releases to air from the SWMU area are estimated to be negligible, therefore, no air monitoring programs are proposed, other than the air monitoring that will occur as part of the health and safety plan. The proposed Phase I RFI workplan tasks are discussed in detail in the following sections. The detailed procedures that will be employed during implementation of these tasks are presented in the QAPP.

### 5.2.1 Installation of Soil Borings for Characterization of Site Soils

Five additional shallow soil borings will be installed at the CRC. In order to confirm whether or not a release has occurred, two borings off-site will be completed upgradient of Tank Farm No. 3, at the locations labeled SB4 and SB5 in Figure 8. The sampling of these borings is contingent upon receiving approval to access the property from the adjacent property owner. These borings will serve to characterize the upgradient extent of impacts or identify the presence of upgradient sources. Three downgradient soil borings will be completed at the locations labeled SB6, SB7, and SB8 in Figure 8. Information from these soil borings will be used to better characterize the nature and extent of hazardous constituent impacts on-site. At a minimum, two samples from each borehole will be submitted for laboratory analysis. The samples submitted for laboratory analysis will be selected based upon field screening of the samples using a Photo-Ionization Detector (PID) in accordance with the procedures in the QAPP. The sampling procedures specified in the QAPP are consistent with IEPA procedures for sampling soils

for volatile organic compound analysis. One of the samples will be selected from the zone of maximum impacts as determined by the screening results. The other sample will be selected from the deeper zone representing the vertical extent of impacts (non detectable screening results).

Soil borings will be advanced (wherever feasible) using the hollow-stem auger drilling method. The hollow-stem auger drilling method does not require the introduction of water or drilling fluids into the borehole, which could compromise the representativeness of samples collected from the boring. In situations where physical features limit the access of drill rigs, borings will be completed with either a hand-driven or a portable power-driven split-spoon sampler, depending upon required depth and material. Use of any other alternate drilling method (e.g. driven casing, mud rotary, air rotary, cable tool, etc.) for this project will be subject to approval by the IEPA.

Discrete soil samples will be collected in accordance with ASTM D1586 for split-spoon sampling or ASTM D1587 for thin-walled tube sampling and consistent with IEPA soil volatile sampling procedures. Samples will be collected from each borehole at two foot intervals as the auger is advanced using split spoon samplers fitted with brass liner sampling tubes. At least one of the liners for each sample will be at least six inches long. Immediately upon opening the sampler, the six inch tube will be removed. If necessary, bentonite will be added to the ends of the sample to minimize headspace. The sample tube will be covered with aluminum foil and capped, if possible. The sample tube will be stored and shipped in accordance with the procedures in the QAPP.

After the sample has been sealed and stored, one of the other brass tubes in the sampler will be extracted from the sample tube. The soil will be screened for volatile organics with a PID, and the reading will be recorded. The soil will be visually classified according to the Unified Soil Classification System (USCS). Soil boring logs will be maintained for each boring. The soil classification, standard penetration blow counts, depth to water table, and other physical characteristics will be recorded on the logs. Only discrete soil samples will be collected; no compositing of samples will be performed. Sampling devices will be decontaminated using Iquinox detergent wash, tap water rinse and distilled water rinse between samples. Drilling augers will be power-washed using high pressure hot water or steam between each borehole.

The borings will be advanced to a depth of approximately 20 ft. or until the screening results indicate that vertical extent of impacts has likely been determined. At a minimum, two soil samples from each borehole will be submitted for laboratory analysis. In addition one sample of the deeper clay unit will be submitted to a qualified soils laboratory for laboratory permeability testing according to ASTM method D 5084. Prior to selecting the samples to be submitted to the laboratory, the visual classifications and PID screening data will be reviewed. The sample from the interval with the highest PID reading and a deeper sample with non detectable screening results will be selected for laboratory analysis. Based upon the existing data, it is expected that the sample representing the highest zone of impacts will be obtained in the fill and silt zones. The sample representing the vertical extent of impacts will likely be obtained from the underlying clay zone. Appropriate personal protective equipment will be worn by all personnel in accordance with the Health and Safety Plan (HASP).

### *5.2.2 Monitoring Well Installation*

Five additional monitoring wells will be installed in or adjacent to the completed soil borings at the site (MW4, MW5, MW6, MW7, and MW8). The proposed locations of these monitoring wells is shown in Figure 8. Two of these will be upgradient from (to the west of) Tank Farm #3, provided that property access can be obtained. One well will be located to the west of the sewer that runs the length of the alley. This well will be the furthest upgradient. The other upgradient well will be located between existing MW-2 and the sewer line. Although the depth and configuration of the trench line for the sewer is unknown at this time, it is possible that the sewer line may serve as a recharge or discharge boundary to the site. Static water level data from the well placed between the sewer and MW-2, in conjunction with other static data and construction information, will aid in identifying the influence of the sewer on the groundwater flow regime near the facility. Information will be obtained from the City engineers regarding this sewer line (location, depth, size, trench fill material).

The other three wells will be placed downgradient from Tank Farm No. 3, to the east and southeast as shown in Figure 8. Data obtained from these wells will better define groundwater flow directions and horizontal downgradient extent of groundwater impacts at the site. Existing information indicates that groundwater generally flows west to east across the site. The locations of the three downgradient wells have been selected to supplement the gaps in the existing groundwater data set, and to provide information along the downgradient boundaries of the SWMU areas.

Existing information indicates that a continuous clay layer underlies the site at an approximate depth of ten feet. The clay layer likely serves as an impermeable barrier impeding vertical downward flow to deeper units in the saturated zone. Chemical transport is, therefore, likely occurring in the more permeable silt and fill material near the surface. Previous boring logs from the site indicate that the clay layer starts at depths from seven to eleven feet below ground surface. For this reason, and to maintain consistency with existing monitoring wells, all proposed monitoring wells will be set to a depth of ten feet, as allowed by subsurface conditions, with the riser extending above ground surface. Preferentially, all wells will be constructed in this manner, however, if the above-ground riser would be an obstruction to traffic or would otherwise create a hazard, the wells will be flush-mounted.

The boring completion depth will likely be greater than the proposed well screen depth. Therefore it will be necessary to grout the boring from the completion depth to the projected screen bottom depth as the augers are retrieved. The monitoring wells will then be installed in the borehole by placing the screen and casing assembly with bottom plug through the hollow-stem augers. The well construction materials will be new, clean, and of sound condition. Wells will be constructed of 2 inch diameter, 0.010 slot stainless steel screen with 2 inch diameter stainless steel risers. A washed silica sand filter pack will be placed in the annular space surrounding and to at least two feet above the screen. If the soil characteristics indicate that a sand filter pack is not necessary, the auger string will be pulled back to allow the natural aquifer material to collapse around and to at least two feet above the screen. A bentonite slurry seal of at least two feet in thickness will then be added to fill the annular space above the sand pack using a tremie tube. Bentonite pellets or chips may be substituted for the bentonite seal if the well screen is relatively near the



water table. The sand pack and bentonite seal will be sounded during installation using a weighted measuring tape to insure that adequate amounts of the material are added. A cement/bentonite grout mixture will then be added to the annulus above the bentonite seal and to within three feet of the surface using a tremie tube during the extraction of the augers.

A protective steel casing (either flush mount or above grade, dependent upon site requirements) will be installed over the well riser and cemented into place so that the cement extends approximately one foot outward from the casing and is sloped to allow water to drain away from the well. The protective steel casing will either be lockable or a locking cap will be placed in the top of the well riser pipe.

The top of the well riser will be marked for use in maintaining consistent groundwater elevation measurements. The elevation of the marked point on the well riser, the ground elevation and the well location will then be surveyed to an existing benchmark using standard instruments and survey techniques.

Monitoring well construction logs will be recorded for each well indicating the screen and riser materials, filter pack and annular seal materials, well dimensions, and casing and screen elevations.

All wells will be developed, after installation, to remove fine-grained materials according to procedures described in the QAPP. Development methods will include surging, overpumping, and bailing techniques. Development will continue until turbidity and pH measurements from sequential samples stabilize. All development water will be collected, containerized, and stored on-site until arrangements are made for proper disposal.

### *5.2.3 Groundwater Sampling*

After all new monitoring wells have been installed, the new and existing monitoring wells will be sampled quarterly for one year according to procedures described in the QAPP. Prior to purging and sampling a well, and after water levels have been allowed to equilibrate in the well for at least 1-2 hours after removal of an unvented well cap, the groundwater static level will be measured from the top of the well casing to the top of the water surface and recorded as a portion of the well sample data. Electronic water level indicators or a chalked steel measuring tape may be used to collect the static level data.

All purge water will be collected, containerized, and stored on-site until arrangements are made for proper disposal. During purging, pH, temperature, and conductivity will be measured and recorded at regular intervals during the purging process. Purging be continued until these measured parameters have stabilized over a period of at least ten minutes or after a minimum of three well volumes have been removed from the well.

The groundwater samples will be collected using either a low flow pump (e.g., bladder pump) or bailer. If a bailer is used, it will be made of Teflon, or disposable polyethylene bailers will also be used provided that a new bailer is used at each well. Groundwater samples will be collected and submitted for laboratory analysis for the compounds listed in Section 5.1. As part of the Phase I RFI, groundwater samples will be collected quarterly for one year.

#### *5.2.4 Determination of Hydrogeologic Properties*

Slug tests will be performed in at least four locations to determine the bulk hydraulic conductivity of the silt and fill layers. These tests will be conducted at MW1, MW2, MW6, and MW8. Although field hydraulic conductivity tests of this type are usually performed to determine the conductive properties of a single lithologic layer or unit, tests at the CRC will be conducted on wells even if the wellscreen spans more than one unit (e.g. the well is screened over both the fill and silt layers). Using this approach, the results of the slug test analysis will yield bulk conductivities. This is acceptable since it is likely that the conductivity of the fill material is orders of magnitude greater than that of the silt and recharge of the well will be dominated by flow from the fill.

The slug tests will be conducted by introducing a solid slug or air slug device into the well in accordance with the procedures in the QAPP. Prior to introducing the slug, a pressure transducer will be lowered into the well to a point near the bottom of the well screen. The lead from the transducer will be connected to a Hermit data logger. When the slug has been introduced into the well and the water level in the well has reached equilibrium, the slug will be rapidly removed. As the water level in the well recovers, the data logger will record the change in pressure at the transducer. Detailed procedures for conducting the slug tests are contained in the QAPP.

The data will be analyzed using the Bouwer and Rice method of analysis for slug test data. This method is applicable to partially penetrating wells in unconfined aquifers. Other methods may be employed if site conditions warrant.

#### *5.2.5 Characterization of Site Lithology to Bedrock*

In order to characterize site lithology to bedrock, a deep soil boring will be installed through the overlying unconsolidated materials to the underlying bedrock. This borehole will be installed in an area devoid of suspected surficial chemical impacts to minimize the potential for creating an impacted vertical conduit to the bedrock. The borehole will be installed using the hollow stem auger method as discussed in Section 5.2.1, in order to allow sampling of the soil at five foot intervals down to bedrock. The location of the water table in the borehole will be noted. It is anticipated that the deep soil boring will be located upgradient of the facility, adjacent to MW4. If impacts are identified at this location, or if access is not forthcoming, an alternate location will be selected.

Discrete soil samples will be collected in accordance with ASTM D1586 for split-spoon sampling or ASTM D1587 for thin-walled tube sampling. Sample tubes will be collected from the borehole at five foot intervals as the auger is advanced. Immediately upon exposing the sampled soil, the soil will be screened for volatile organics with a PID, and the reading will be recorded. If elevated readings are noted, the boring will be decommissioned and backfilled with bentonite. The soil in the sample tube will be visually classified according to the Unified Soil Classification System (USCS). Sampling tubes will be decontaminated using liquinox detergent wash, tap water rinse and distilled water rinse between samples. Drilling augers will be power-washed using high pressure hot water or steam between each borehole. No soil samples will be submitted for laboratory analyses form this boring.

#### *5.2.6 Air Quality Evaluation*

Screening level mass loading calculations have been completed that indicate that air emissions from the SWMUs will likely not pose a threat to human health or the environment (see Attachment A). These screening calculations were based on methods presented by the USEPA for the calculation of volatilization of chemicals released directly onto surface soils (USEPA, 1988). These calculations used data collected in relation to the closure of Tank Nos. T-190 through T-193 in 1991. The following conservative assumptions were made in performing the calculations:

- ambient temperature = 20oC
- total porosity of soil = 0.2
- depth of dry soil = 25 cm
- approximately 50 % of the SWMU area is covered by concrete

Groundwater and bulk soil concentrations were derived by taking the average of the data for samples collected outside of Tank Farm No. 3. The average data values obtained in this manner likely provide a conservative estimate of actual concentrations in the SWMU area. The loading rate was calculated for a time equal to two years after the data were collected. The calculations show that the loading rate from the SWMU area is 0.02 lbs/hr. By comparison, according to the RCRA Part B permit for the CRC, the regulatory limit on air emissions from all process vents at a facility has been established as 3 lbs/hr in order to protect human health. The 3 lbs/hr was determined by the EPA using a human exposure model. The limit is estimated to result in an acceptable maximum individual risk. The calculated loading rate for the SWMU areas is significantly lower than the regulatory limit, indicating that health risks would be well within acceptable limits, and therefore there is no further need for characterization of the SWMU area's impact on local air quality. However, during drilling operations, air quality in the vicinity of the borehole will be monitored, according to procedures described in the QAPP, to ensure worker safety.

### *5.2.7 Source Characterization*

Analytical data will be collected in order to completely characterize the hazardous wastes and/or hazardous constituents and the areas where hazardous wastes and/or hazardous constituents have been released, placed, collected, or removed, including: type, quantity, physical form, disposition, and facility characteristics affecting the release(s). The permit requires that these investigations include identification of the following specific characteristics at each source area:

- Unit Area characteristics
  - a. Location
  - b. Type
  - c. Design features
  - d. Operating practices (past and present)
  - e. Period of operation
  - f. Age
  - g. General physical conditions
  - h. Structural integrity
  - i. Method used to close unit
- 1. Waste or Hazardous Constituent characteristics
  - a. Type
    - 1. Source
    - 2. Hazardous classification
    - 3. Quantity
    - 4. Chemical composition
  - b. Physical and Chemical characteristics
    - 1. Physical form
    - 2. Physical description
    - 3. Temperature
    - 4. pH
    - 5. General chemical class (e.g. acid, solvent)
    - 6. Molecular weight
    - 7. Density
    - 8. Boiling point
    - 9. Viscosity
    - 10. Solubility in water
    - 11. Cohesiveness of the waste
    - 12. Vapor pressure
    - 13. Flash point
  - c. Migration and Dispersal characteristics
    - 1. Sorption
    - 2. Biodegradability, bioconcentration
    - 3. Photodegradation rates
    - 4. Hydrolysis rates
    - 5. Chemical transformations

2. Human Use of, or access to, the facility
  - a. Recreation
  - b. Agriculture
  - c. Residential

Several of these requirements are not pertinent to the SWMU areas at the CRC, including: 2a, 2b, and 2c. No information is proposed to be collected to address these issues as part of the Phase I RFI. Further reasonably accurate quantitative estimates for some of the characteristics, properties and processes identified in 1 are difficult if not practically impossible to estimate due to their dependence on available literature estimates, complex site-specific characteristics or dependence on available site historical information. Therefore, these factors can generally be only qualitatively characterized. The Phase I RFI will qualitatively characterize these factors where information is readily available.

#### *5.2.8 Description of Potential Receptors*

The permit also require that data be collected to describe the human populations and environmental systems, within a radius of 1500 feet of the CRC facility boundary. Again, several of these issues are not pertinent to CRC SWMU areas. The following characteristics are required, and those that are not pertinent to SWMU areas are noted. Information will be gathered only for the pertinent characteristics :

1. Local uses and possible future uses of groundwater
  - a. Type of use
  - b. Location of users, including wells and discharge areas
2. Local uses and possible future uses of surface waters draining the facility (not pertinent to the SWMU areas)
3. Zoning
4. Location between population locations and prevailing wind direction
5. Demographic profile of people that have access to the facility (age, sex, sensitive subgroups) (not pertinent)
6. Endangered or threatened species (not pertinent)

#### **6. Submission of Reports and Results of RFI Activities**

In accordance with the requirements of the permit, quarterly progress reports and a final Phase I RFI report will be prepared and submitted to IEPA on the dates specified in the project schedule. The quarterly reports will contain at a minimum:

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- A. An estimate of the percentage of the investigation completed.
- B. Summary of activities completed during the reporting period
- C. Summaries of all actual or proposed changes to the Workplan or its implementation
- D. Summaries of all actual or potential problems encountered during the reporting period
- E. Proposal for correcting any problems
- F. Projected work for the next reporting period
- G. Other information or data as requested in writing by IEPA

The Phase I report will summarize the investigation tasks, deviations from specified procedures (if any), all data collected, the quality assurance review, data evaluations, and findings of the Phase I RFI.

## **References**

USEPA, Superfund Exposure Assessment Manual, Office of Remedial Response,  
Washington, D.C., 1988.

**Table 1**  
**Summary of Soil Sampling Results for Pre-Closure Investigation**  
**Safety-Kleen Corp.: Chicago Recycle Center**  
**(from Canonie, 1991)**

Compound	Results (mg/kg)														
	S1-SH	S1-DE	S2-SH	S2-DE	S3-SH	S3-DE	S4-SH	S4-DE	S5-SH	S5-DE	S6-SH	S6-DE	S7-SH	S8-SH	S8-DE
<u>Volatiles</u>															
Methylene Chloride	<0.005	<0.005	<0.005	<0.005	<0.5	<0.25	<0.5	26	2.9	6.9	<0.005	<0.5	<0.005	<0.25	<5.0
Acetone	<0.1	<0.1	<0.1	<0.1	<10.0	<5.0	<10.0	<10.0	<5.0	<5.0	<0.1	<10	<0.1	<5.0	<100.0
1,1,1 - Trichloroethane	<0.005	0.013	<5.0	0.087	24	66	21	2000	13	47	0.45	21	0.014	10	38
Trichloroethene	0.036	0.92	0.0073	1	40	86	55	2800	83	300	1.3	50	0.047	97	590
Tetrachloroethene	<0.005	<0.005	<0.005	0.27	55	50	25	42	11	16	0.29	12	0.02	28	43
Toluene	<0.005	0.012	<0.005	0.032	2.5	1.9	8.8	44000	10000	27000	<0.005	4	0.027	12000	33000
Freon 113	<0.005	<0.005	<0.005	<0.005	1.9	2.3	3.5	<5.0	<0.25	1.9	0.055	5.9	0.051	3.4	<5
Tetrahydrofuran	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
<u>Semivolatiles</u>															
N,N - Dimethylacetamide	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
B - Picoline								***See Below***							
Pyridine	<0.66	<0.33	<1.3	0.054	<6.6	<0.33	<1.7	0.39	3.5	0.47	<0.99	0.68	<2.5	<2.5	<0.66
1-methyl-2-Pyrrolidinone	ND	ND	ND	ND	ND	0.16	ND	17	1.8	5.8	ND	2.5	ND	ND	ND
<u>Methyl-pyridine isomer</u>															
Scan 249	0.61	4.2	1				ND	1.4						38	
Scan 256	3.2						ND				1.1				
Scan 255		1.5		8.6			ND		340						
Scan 254					3.3		ND								
Scan 265							ND	310							
Scan 266							ND		53						
Scan 252							ND						0.7		
Scan 284							ND			880					
Scan 250							ND				0.64				
Scan 253							ND					18			
Scan 258							ND								57



**Table 2**  
**Summary of Groundwater Sampling Results for Post-Tank Closure Investigation**  
**Safety-Kleen Corp.: Chicago Recycle Center**  
**(from Canonie, 1991)**

Compound	Results (mg/l)			
	P1	P2	P3	P4
Chloromethane	<10	<1 L	<0.002	<0.02
Bromomethane	<10	<1 L	<0.002	<0.02
Vinyl Chloride	<5	<0.5 L	<0.001	<0.01
Dichlorodifluoromethane	<10	<1 L	<0.002	<0.02
Chloroethane	<10	<1 L	0.0044	0.024
Methylene Chloride	9.5	<0.5 L	0.0019	0.012
Fluorotrichloromethane	<10	<1 L	<0.002	<0.02
1,1 - Dichloroethylene	<5	<0.5 L	<0.001	<0.01
1,1 - Dichloroethane	<5	<0.5 L	0.023	0.096
1,2 - Dichloroethylene (total)	<5	<0.5 L	0.0048	0.021
Chloroform	50	<0.5 L	0.0011	<0.01
1,2 - Dichloroethane	<5	<0.5 L	<0.001	<0.01
1,1,1 - Trichloroethane	<10	<1 L	<0.002	0.029
Carbon Tetrachloride	<5	<0.5 L	<0.001	<0.01
Bromodichloromethane	<5	<0.5 L	<0.001	<0.01
1,2 - Dichloropropane	<5	<0.5 L	<0.001	<0.01
cis - 1,3 - Dichloropropylene	<10	<1 L	<0.002	<0.02
Trichloroethylene	<10	<1 L	0.0032	0.028
Benzene	<5	<0.5 L	<0.001	<0.01
1,1,2 - Trichloroethane	<5	<0.5 L	<0.001	<0.01
trans - 1,3 - Dichloropropylene	<10	<1 L	<0.002	<0.02
Chlorodibromomethane	<5	<0.5 L	<0.001	<0.01
2 - Chloroethylvinyl ether	<25	<2.5 L	<0.005	<0.05
Bromoform	<5	<0.5 L	<0.001	<0.01
Tetrachloroethylene	<10	<1 L	<0.002	<0.02
1,1,2,2 - Tetrachloroethane	<10	<1 L	<0.002	<0.02
Toluene	470	<0.5 L	<0.001	<0.01
Chlorobenzene	<5	<0.5 L	<0.001	<0.01
Ethylbenzene	<5	<0.5 L	<0.001	<0.01
Xylenes	<15	<1.5 L	<0.003	<0.03
1,3 - Dichlorobenzene	<5	<0.5 L	<0.001	<0.01
1,2 - Dichlorobenzene	<5	<0.5 L	<0.001	<0.01
1,4 - Dichlorobenzene	<5	<0.5 L	<0.001	<0.01

L = sample could not run at lower dilution because of high levels of unrequested compounds.

**Table 3**  
**Summary of Soil Gas Analysis Results for Post-Tank Closure Investigation**  
**Safety-Kleen Corp.: Chicago Recycle Center**  
**(from Canonie, 1991)**

Sample Location	Sample Depth (ft)	Saturated/Unsaturated	Soil Gas Concentration (ml/l)		
			Toluene	TCE	PCE
Inside Tank Farm No. 3					
P1	1.5	S	2.7	0.025	BD
H7	1.5	S	2.232	0.974	BD
H6	1.5	S	2.48	0.51	BD
H10	0.5	U	0.00034	0.00076	0.00122
H10	0.3	S	1.6	11	BD
H9	1.5	S	0.38	0.0075	BD
H8	1.5	U	BD	BD	BD
Outside Tank Farm No. 3					
H5	2.0	U	0.0042	0.0072	BD
P2	0.5	U	BD	0.00021	BD
P2	3.5	S	0.0205	BD	BD
H11	0.5	U	0.00002	0.0032	BD
H11	3.5	S	0.00785	0.00005	BD
P3	3.5	S	0.0017	0.00035	BD
P4	3.0	S	0.00512	BD	BD
P4	4.0	S	0.00065	BD	BD

**Table 4a**  
**Summary of Soil Sampling Results for Supplemental Investigation**  
**Safety-Kleen Corp.: Chicago Recycle Center**  
**(from Canonic, 1991)**

Compound	Results (mg/kg)													
	B1-2A 2 - 4 ft	B1-3 4 - 6 ft	B2-2 2 - 4 ft	B2-5 8 - 10 ft	B3-4 6 - 8 ft	B3-5 8 - 10 ft	B3-6 10 - 12 ft	B4-4 6 - 8 ft	B4-5 8 - 10 ft	B4-6 10 - 12 ft	B4-7 12 - 14 ft	B4-8 14 - 16 ft	B4-9 16 - 18 ft	B4-10 18 - 20 ft
<u>Volatiles</u>														
Toluene	0.008	0.027	0.017	0.087	0.11	1.2	6.8	0.41	0.029	0.008	ND	0.012	BDL	0.009
Chloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trichlorofluoromethane	ND	BDL	ND	BDL	BDL	ND	0.17	ND	ND	ND	ND	ND	ND	ND
1,1,1 - Trichloroethane	0.008	0.011	0.037	0.12	BDL	0.31	11	BDL	0.01	ND	ND	BDL	ND	ND
Trichloroethene	0.2	0.072	0.32	0.5	0.039	5.6	13	0.039	0.052	ND	ND	0.009	ND	BDL
Tetrahydrofuran	ND	BDL	ND	BDL	0.036	0.37	0.086	0.2	0.028	0.01	BDL	ND	BDL	BDL
Tetrachloroethene	BDL	ND	0.008	BDL	BDL	1.5	8.9	BDL	ND	ND	ND	ND	BDL	ND
Acetone	0.022(B)	0.031(B)	0.025(B)	0.180(B)	0.004(B)	ND	0.110(B)	0.083(B)	0.390(B)	0.028(B)	0.013(B)	0.019(B)	BDL	0.016(B)
<u>Semivolatiles</u>														
Pyridine	ND	BDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
B - Picoline	ND	40	BDL	0.54	1.1	0.63	1.8	11	0.75	0.47	ND	ND	BDL	ND
N,N - Dimethylacetamide	ND	BDL	ND	ND	ND	ND	BDL	ND	ND	ND	ND	ND	ND	ND
1-methyl-2-Pyrrolidinone	ND	0.61	BDL	BDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

ND = Nondetectable

BDL = Below Detection Limit

B = Compound found in blank and sample

**Table 4b**  
**Summary of Soil Sampling Results for Supplemental Investigation**  
**Safety-Kleen Corp.: Chicago Recycle Center**  
 (from Canonie, 1991)

Compound	Results (mg/kg)														
	B5-2 2 - 4 ft	B5-3 4 - 6 ft	B5-4 6 - 8 ft	B5-5 8 - 10 ft	B5-6 10 - 12 ft	B6-3 4 - 6 ft	B6-5 8 - 10 ft	B8-2 2 - 4 ft	B8-5 8 - 10 ft	MW1-3 4 - 6 ft	MW1-4 6 - 8 ft	MW2-4 6 - 8 ft	MW2-6 10 - 12 ft	MW3-3 4 - 6 ft	MW3-6 10 - 12 ft
<u>Volatiles</u>															
Toluene	100	130	520	82	320	5.6	0.036	6.9	0.85	0.54	2.3	3.5	2.3	0.46	0.031
Chloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trichlorofluoromethane	ND	0.62	6.3	0.28	2	ND	ND	ND	0.43	ND	ND	ND	ND	ND	ND
1,1,1 - Trichloroethane	0.7	140	120	220	420	ND	ND	ND	ND	BDL	ND	0.46	0.52	BDL	0.011
Trichloroethene	9.9	510	380	740	530	BDL	0.047	ND	1.3	0.6	0.8	8.4	5.2	0.34	0.055
Tetrahydrofuran	BDL	ND	ND	2.5	0.74	3.4	0.97	16	2.4	0.36	0.31	1.4	0.96	1.5	0.03
Tetrachloroethene	1	4.5	8.9	2.8	ND	ND	ND	ND	4.7	ND	ND	0.61	0.4	ND	ND
Acetone	2.2(B)	22.0(B)	13.0(B)	39.0(B)	ND	2.2(B)	BDL	ND	0.430(B)	BDL	0.370(B)	3.4(B)	0.850(B)	0.310(B)	0.31
<u>Semivolatiles</u>															
Pyridine	31	83	330	280	120	BDL	BDL	ND	ND	BDL	BDL	BDL	17	ND	ND
B - Picoline	330	410	1400	1300	660	30	13	4	ND	39	5	570	310	7.7	ND
N,N - Dimethylacetamide	BDL	320	3400	5200	3000	1800	590	ND	ND	BDL	BDL	2500	2600	70	10
1-methyl-2-Pyrrolidinone	13	31	52	64	310	70	83	ND	ND	BDL	ND	13	17	1.6	BDL

ND = Nondetectable

BDL = Below Detection Limit

B = Compound found in blank and sample

**Table 5**  
**Summary of Groundwater Sampling Results for Supplemental Investigation**  
**Safety-Kleen Corp.: Chicago Recycle Center**  
**(from Canonie, 1991)**

Compound	Results (mg/l)		
	MW1	MW2	MW3
<u><b>Volatiles</b></u>			
Toluene	0.53	300	1.8
Chloromethane	ND	ND	ND
Trichlorofluoromethane	ND	5.5	ND
1,1,1 - Trichloroethane	BDL	2.5	ND
Trichloroethene	0.057	16	ND
Tetrahydrofuran	2.1	ND	3
Tetrachloroethene	ND	0.44	ND
Acetone	0.13	ND	0.23
<u><b>Semivolatiles</b></u>			
Pyridine	BDL	2.4	BDL
B - Picoline	2.7	290	4.6
N,N - Dimethylacetamide	0.18	850	22
1-methyl-2-Pyrrolidinone	0.11	12	0.16

ND = Nondetectable

BDL = Below Detection Limit

**Table 6**  
**Summary of Qualifications**  
**for LTI Staff Assigned to the Safety-Kleen CRC Phase I RFI**

Name	Project Role	Degrees	Professional Experience (years)
Paul F. Freedman, P.E.	Project Administrator	B.S.E. Civil Engineering	20
		M.S.E. Environmental Engineering	
Gregory W. Peterson	Project Manager	B.S.E. Civil Engineering	9
		B.S.E. Environmental Engineering	
Scott B. Bell	Project Engineer	B.S. Environmental Studies	1
		M.S. Civil Engineering	
Robert J. Betz	Project Scientist	B.S. Biological Sciences	4
		M.S. Environmental Health Sciences	
Jing Chen	Assistant Hydrogeologist	B.S. Hydrogeology	7
		M.S. Environmental Studies	
Joyce Dunkin	Project Hydrogeologist	B.S. Mathematics	8
		M.S. Geology	
		M.S. Environmental Engineering	
Jonathan B. Farr	Assistant Geologist	B.S. Geology	1
		B.S. Computer Science	
Brian Lord	Environmental Technician	B.S. Industrial Hygiene	1
John T. Peterson	Environmental Technician	B.S. Biology	4
James Richards	Project Hydrogeologist	B.S. Geologic Engineering	8
		M.S. Environmental Engineering	
		c.Ph.D. Geology/Environmental Engineering	
Catherine Whiting	Project Engineer	B.S. Biology	9
		M.S. Civil Engineering	

LTI, Limno-Tech Inc.  
01-May-93

**Table 7**  
**ESTIMATED COSTS**  
**Phase I RCRA Facility Investigation**  
**Safety-Kleen Corp.: Chicago Recycle Center**

TASK	HOURS BY LABOR CATEGORY				Total
	LTI Labor	Drillers*	Laboratory	Other Direct	
1. Project Management	\$2,500.00	\$0.00	\$0.00	\$500.00	\$3,000.00
2. Field Activities	\$10,000.00	\$10,000.00	\$25,200.00	\$2,500.00	\$47,700.00
3. Data Reduction & Evaluation	\$10,000.00	\$0.00	\$0.00	\$500.00	\$10,500.00
4. Source & Potential Receptor Characterization	\$1,000.00	\$0.00	\$0.00	\$100.00	\$1,100.00
4. Phase I RFI Report Preparation	\$10,000.00	\$0.00	\$0.00	\$1,000.00	\$11,000.00
TARGET	\$33,500.00	\$10,000.00	\$25,200.00	\$4,600.00	\$73,300.00

\*Drilling costs are approximate. Drilling work will be awarded on a competitive bidding basis.

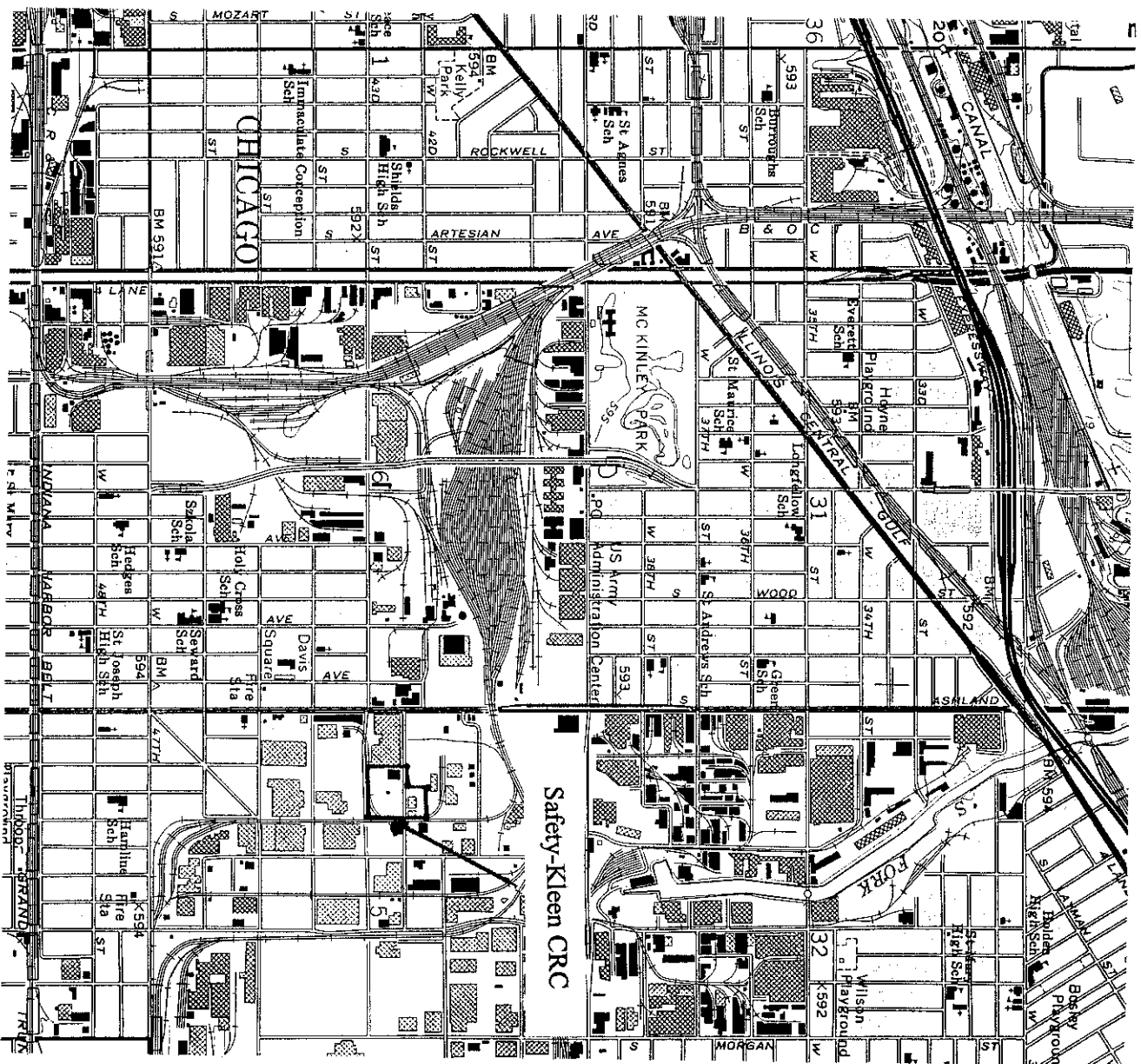


Figure 1: Site Location

NO.	REVISIONS	BY	PROJECT NO.
1			5001
2			FIGURE NO.
3			
4			
5			
6			
7			
8			
9			
10			



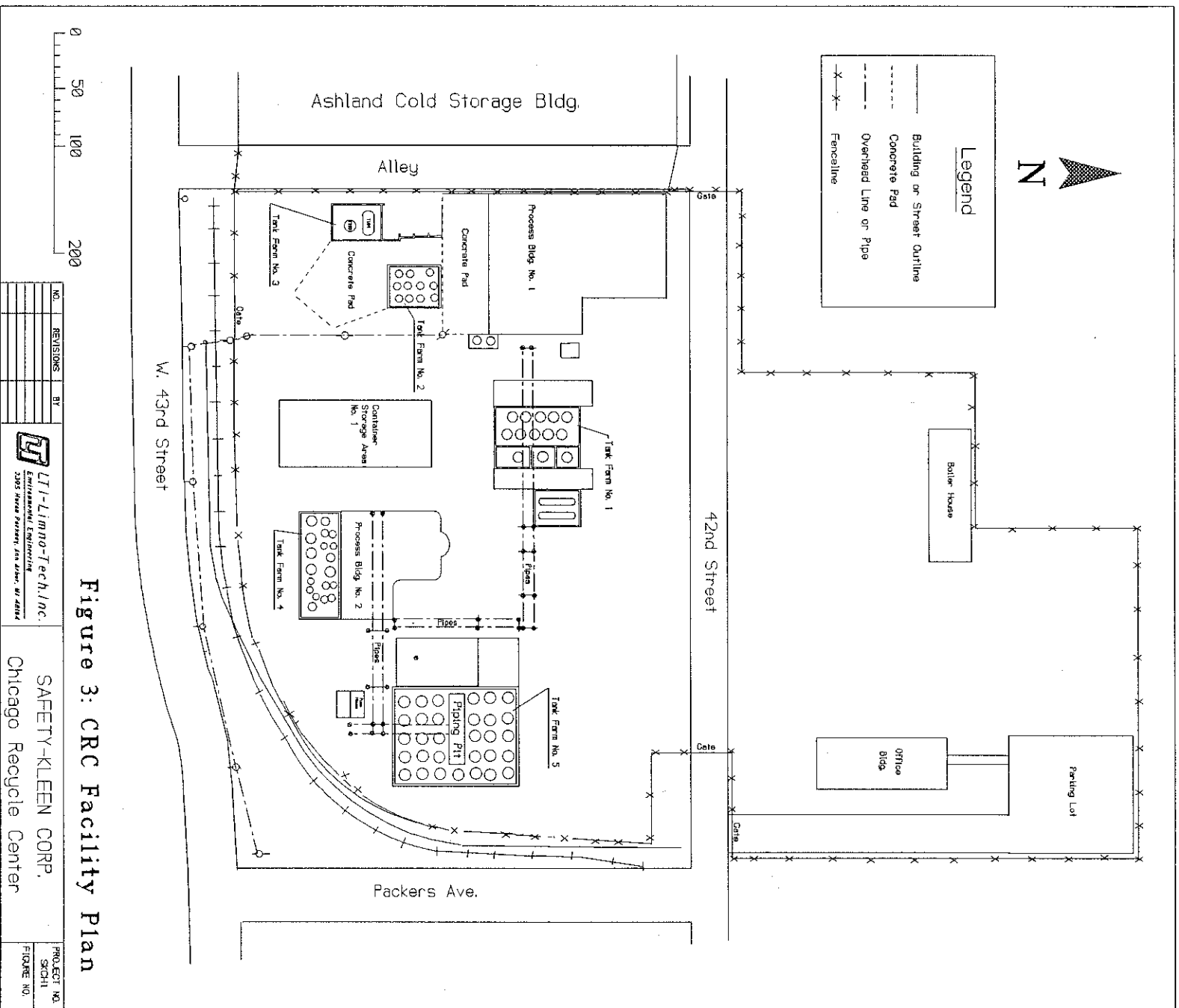
U-I-Li-mo-Tech, Inc.  
Environmental Engineering  
2905 State Parkway, 4th Floor, WI 48104

SAFETY-KLEEN CORP.  
Chicago Recycle Center









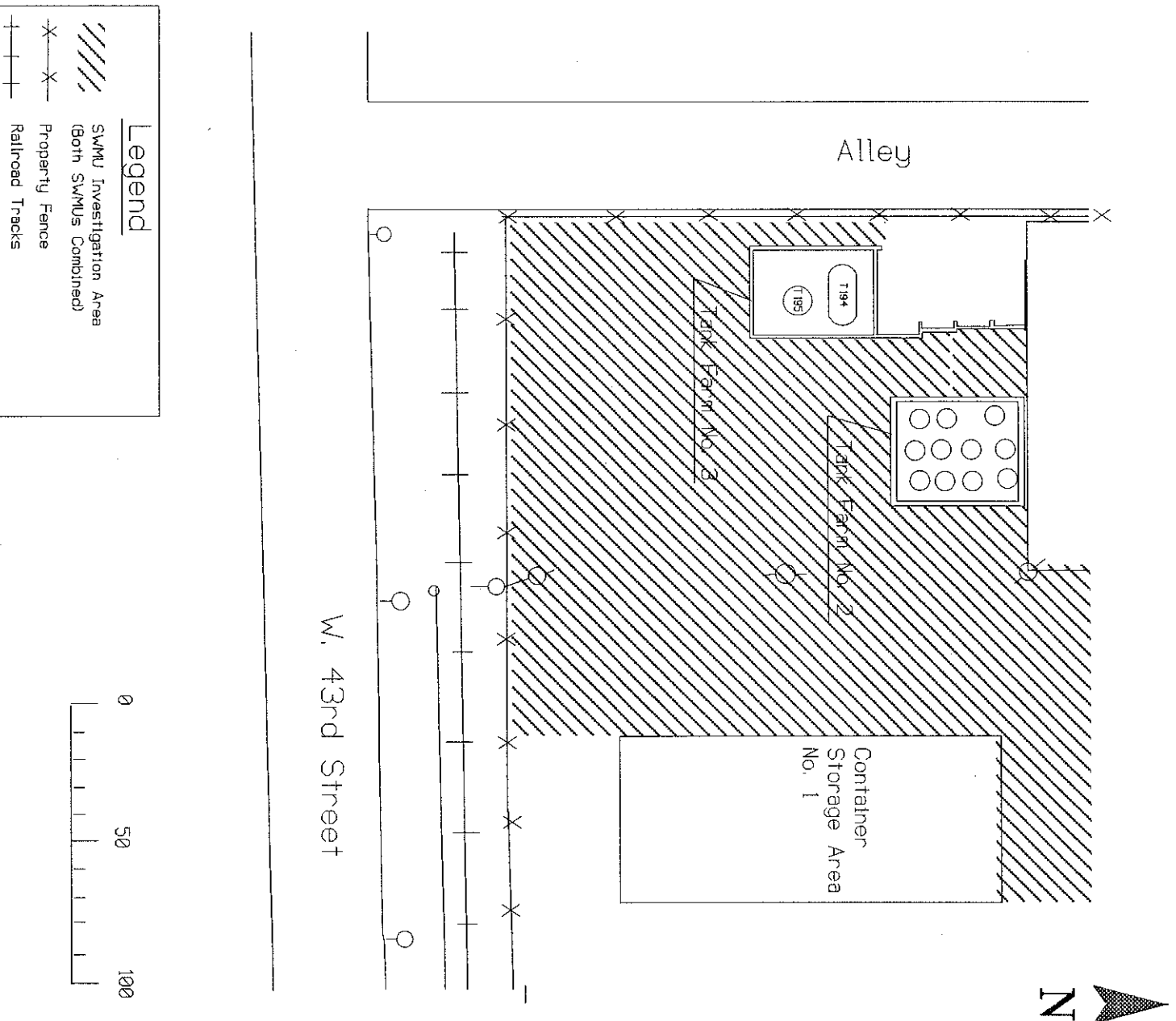


Figure 4: SWMU Investigation Area

No.	REVISIONS	BY
2	4/30/93	SCB



LTI-Limno-Tech, Inc.  
Environmental Engineering  
2295 Irving Park, Ste. 400, Chicago, IL 60614

SAFETY-KLEEN CORP.  
Chicago Recycle Center

PROJECT NO.
SKCH1
FIGURE NO.

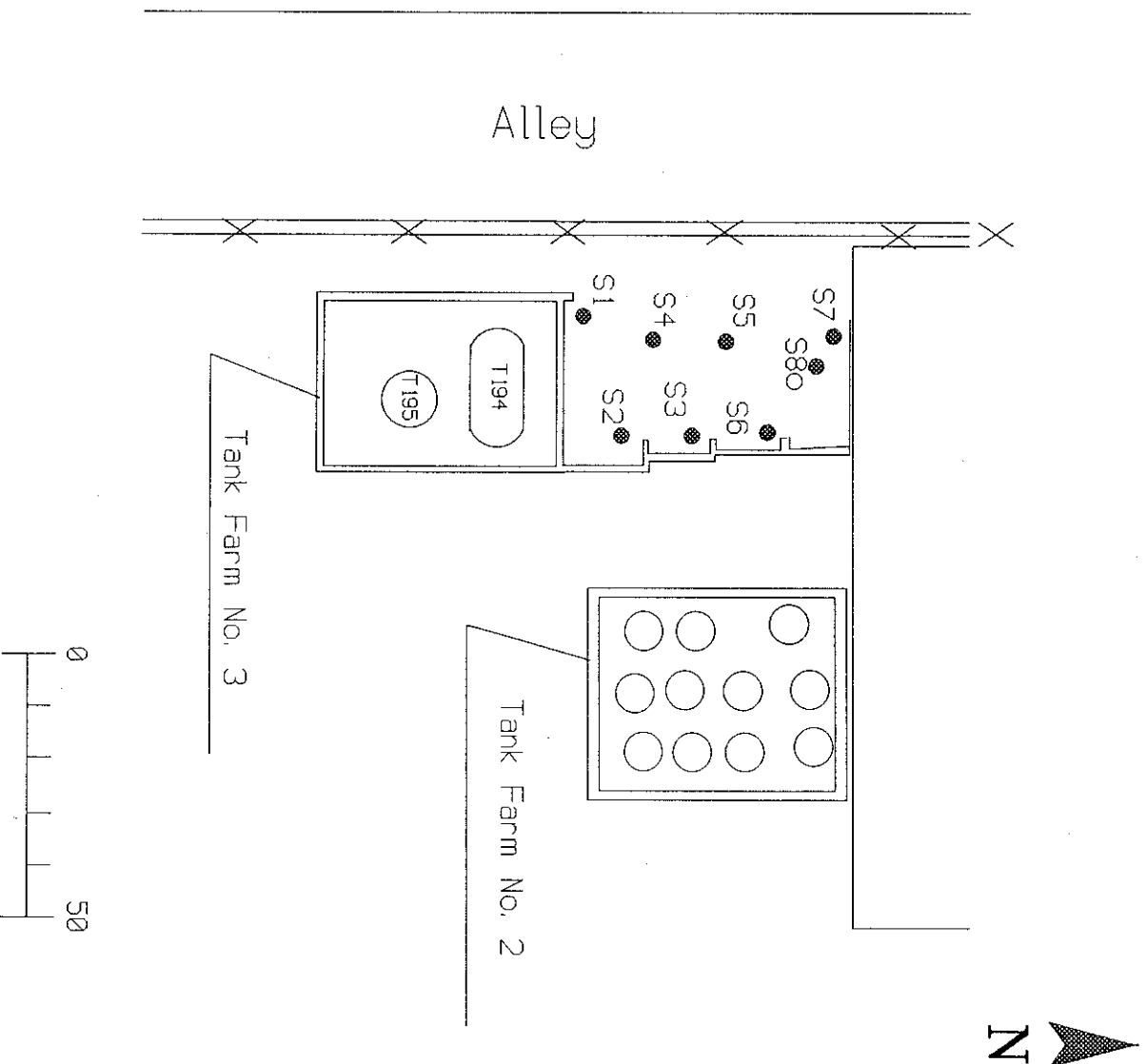

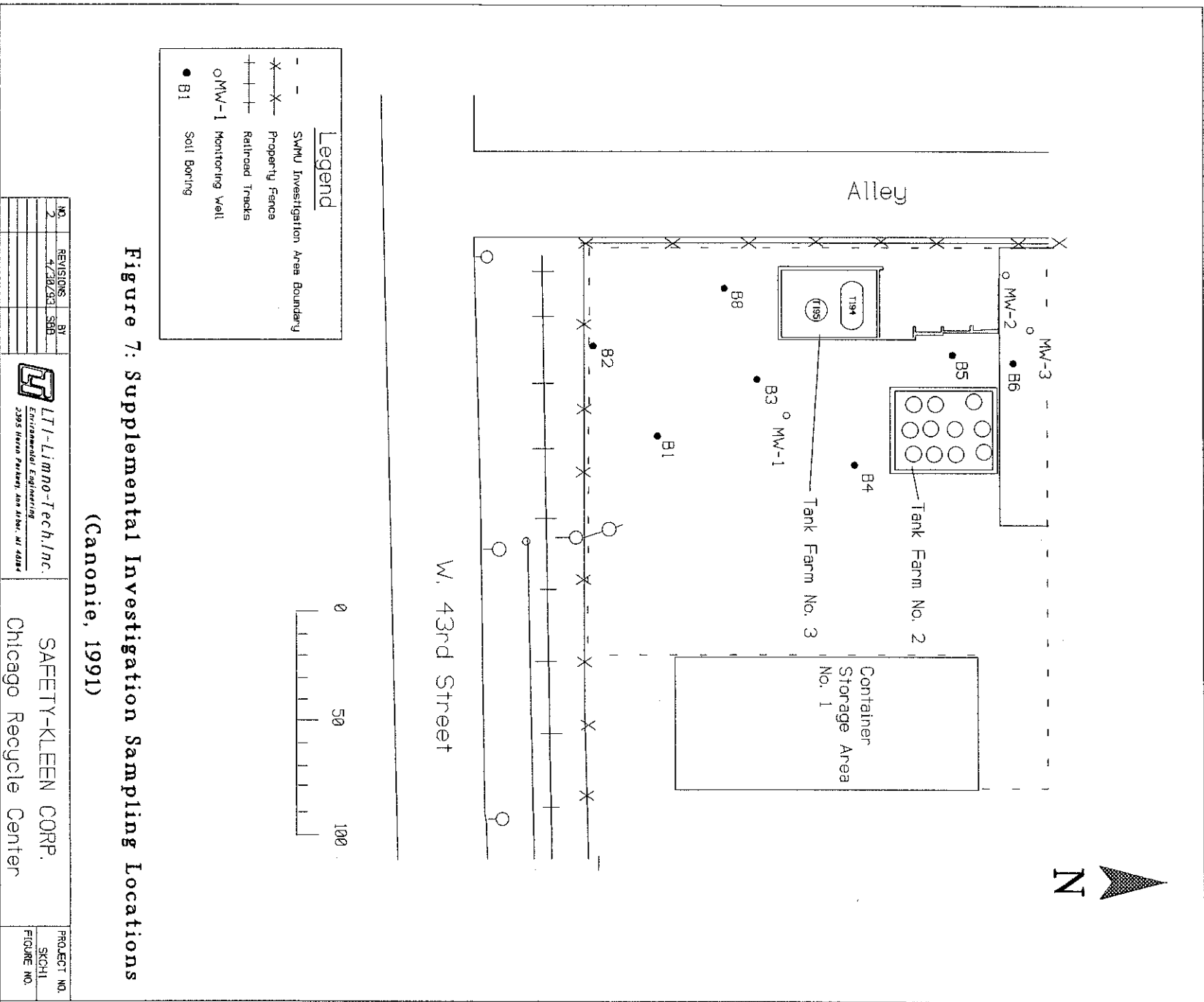


Figure 5: Pre-Closure Soil Sample Locations  
(from Canonie, 1991)

NO.	REVISIONS		BY	 LT/Limno-Tech, Inc. Environmental Engineering 2395 Niles Parkway, Ann Arbor, MI 48104	PROJECT NO.	FIGURE NO.
				SAFETY-KLEEN CORP. Chicago Recycle Center	SCH1	



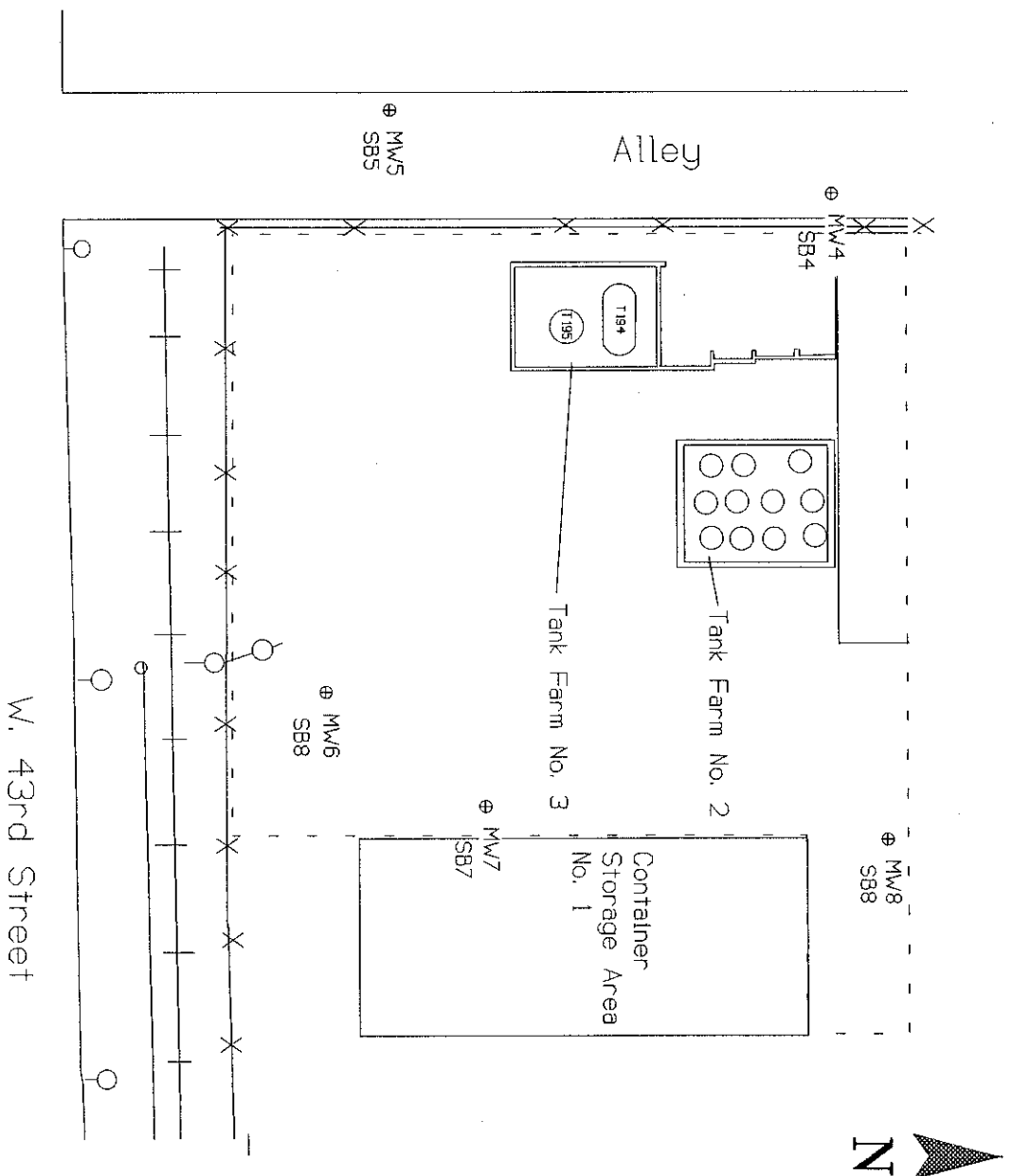


**Figure 7: Supplemental Investigation Sampling Locations**  
 (Canonie, 1991)

NO.	REVISIONS		BY	PROJECT NO.
	DATE	DESCRIPTION		
2	4/28/93	SBO		SKCH1
				FIGURE NO.

**LTI-Limno-Tech, Inc.**  
 Environmental Engineering  
 2395 Hiram Parken, Ann Arbor, MI 48104

**SAFETY-KLEEN CORP.**  
 Chicago Recycle Center



**Legend**

- - - SWMU Investigation Area Boundary
- X - Property Fence
- + - Railroad Tracks
- ⊕ MW Monitoring Well
- ⊕ Access permitted required for off-site wells

**Figure 8: Proposed Monitoring Well Locations**

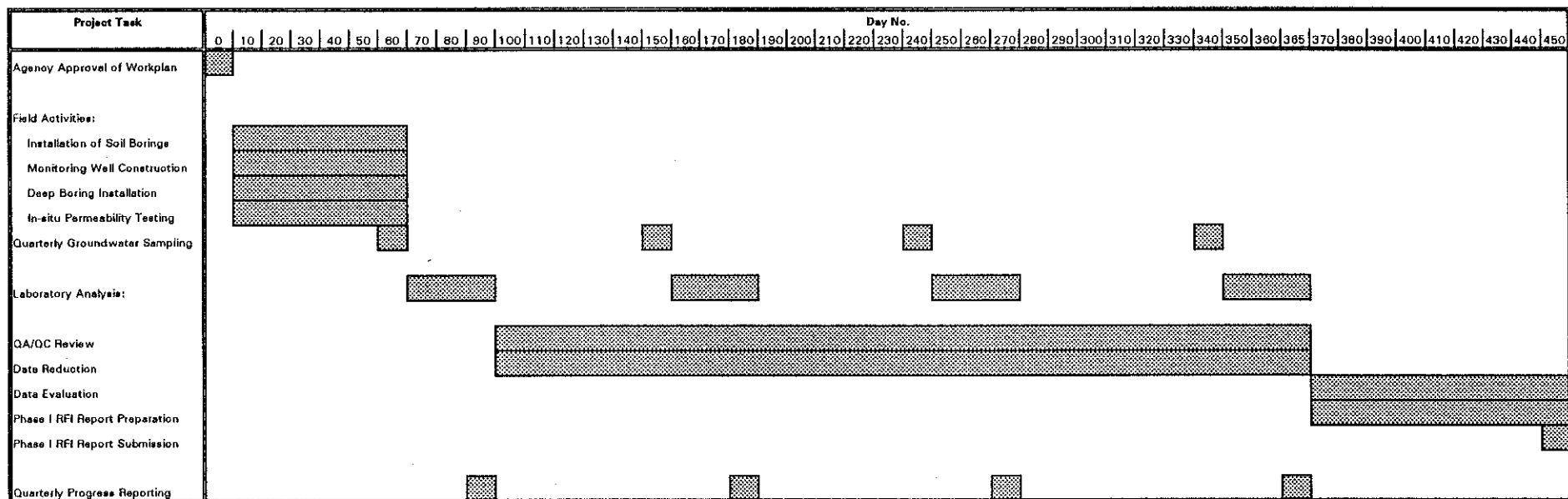
NO.	REVISIONS	BY
2	7/20/93	SB8

**LTi-Limno-Tech, Inc.**  
*Environmental Engineering*  
 2395 Niles Parkway, Ann Arbor, MI 48104

**SAFETY-KLEEN CORP.**  
 Chicago Recycle Center

PROJECT NO.
SKCH1
FIGURE NO.

**Figure 9**  
**Project Schedule**  
**Phase I RCRA Facility Investigation**  
**Safety-Kleen Corp.: Chicago Recycle Center**





## **Attachment A**

### **Air Quality Screening Calculation Spreadsheet**

**SKCH1:****Air Loading Calculations for Organic Compound Volatilization  
from Soils at Safety-Kleen Chicago Recycle Center****Equations:**

Average Loading Rate (g/sec):

$$E_i = (2 \cdot D \cdot C_s \cdot A) / (d + (((2 \cdot D \cdot C_s \cdot t) / C_b) + d^2)^{0.5})$$

Phase transfer coefficient (cm<sup>2</sup>/sec)

$$D = D_i \cdot (P_t^{4/3}) \cdot H_i'$$

Diffusion coefficient of component i in air (cm<sup>2</sup>/sec)

$$D_i = 1.9 \cdot (MW_i^{-2/3}) \cdot (T_a / 293.15)^{1.75}$$

Concentration form of Henry's constant

$$H_i' = H_i / (R \cdot T_a)$$

**Where:**Cb = Bulk concentration of constituent in soil (g/cm<sup>3</sup>)Cs = Liquid-phase concentration of constituent in soil (g/cm<sup>3</sup>)A = contaminated surface area (cm<sup>2</sup>)

Pt = total porosity (unitless)

Mi = mole fraction of toxic component in waste (gmole/gmole)

d = depth of dry soil zone at time of sampling (cm)

MWi = molecular weight of chemical (g/mole)

Ta = ambient temperature (degrees Kelvin)

R = molar gas constant (torr-cm<sup>3</sup>/mole-K)

Vpk = measured vapor pressure of chemical (torr)

Tb = boiling temperature for chemical (K)

Tk = temperature for vapor pressure measurement of chemical (K)

Given:

Environmental Variables:

$T_a(\text{worst case}) = 293.15 \text{ K}$  (ambient temperature)  
 $A = 2.40\text{E}+07 \text{ cm}^2$  (ground surface area)  
 $P_t = 0.2$  (total soil porosity)  
 $d = 25 \text{ cm}$  (depth of dry soil)  
 $R = 8.2054\text{E}-05 \text{ atm-m}^3/\text{mole-K}$  (universal gas constant)  
 $\rho_{\text{hob}} = 1600 \text{ kg/m}^3$  (bulk soil density)

Calculations for multiple compounds:

$t = 63072000 \text{ seconds}$  (= 2 years)

(using average values, outside Tank Farm No. 3)

Compound	Molecular Weight	Henry's Constant	Henry's Constant	Bulk Conc.	Bulk Conc.	Diffusion Coefficient	Phase Transfer Coefficient	Liquid Conc.	Liquid Conc.	Loading Rate	Loading Rate
	MW (g/mole)	H <sub>i</sub> (atm-m <sup>3</sup> /mol)	H <sub>i</sub> (-)	C <sub>b</sub> (ug/kg)	C <sub>b</sub> (g/cm <sup>3</sup> )	D <sub>i</sub>	D	C <sub>s</sub> (ug/l)	C <sub>s</sub> (g/cm <sup>3</sup> )	E <sub>i</sub> (max) (g/sec)	E <sub>i</sub> (max) (lb/hr)
Pyridine	79.1	0.0000355	0.0015	144000	0.0002304	0.1031	1.77984E-05	2400	0.0000024	4.06E-05	0.000323
1,1,2,2-Tetrachloroethene	165.8	0.0083	0.3451	3000	0.0000048	0.0630	0.002540733	440	0.00000044	2.71E-04	0.002149
Toluene	92.1	0.0057	0.2370	44000	0.0000704	0.0932	0.002582096	1165	0.000001165	1.41E-03	0.011176
1,1,1-Trichloroethane	133	0.018	0.7483	61000	0.0000976	0.0729	0.006382273	29	0.000000029	1.63E-04	0.001296
Trichloroethene	131.5	0.01	0.4157	96000	0.0001536	0.0735	0.00357262	29	0.000000029	9.63E-05	0.000764
TOTAL LOAD:											0.02 (lb/hr)

a: Only groundwater was sampled. Bulk concentration has been estimated from groundwater value.

Both groundwater and soil were sampled and tested for these compounds.

Henry's constant not known for these compounds.

**PHASE I RCRA FACILITY INVESTIGATION  
DATA MANAGEMENT PLAN**

**Safety-Kleen Corporation  
Chicago Recycle Center  
Cook County, Illinois**

*Prepared for:*  
**Safety-Kleen Corporation  
Elgin, IL**

*Prepared by:*  
**LTI, Limno-Tech, Incorporated  
Ann Arbor, MI**

**May 3, 1993**

## **1. Introduction**

A Phase I RCRA Facility Investigation (RFI) at the Safety-Kleen Chicago Recycle Center is required as part of the operating license for the facility. This Data Management Plan is one of the requirements contained in the facility's Part B permit. The Data Management Plan will be used in conjunction with the Phase I RFI Quality Assurance Project Plan (QAPP) and Work Plan to assure accurate and accessible data for analysis and reporting. The reader should refer to those documents for descriptions of the facility, project organization, sampling and analytical methods, and the sample locations and parameters to be analyzed.

The data management plan established for the Phase I RFI includes procedures for field activities, sample management and tracking, presentation of data, and document control and management (USEPA, 1988). The procedures for each of these is discussed below.

## **2. Data Record**

During site characterization and sampling consistent documentation and accurate record keeping will be maintained to assure the validity of the data obtained. Standardized procedures will be used for sample labeling, documentation of field activities and observations, data security, and quality assurance and quality control.

### **2.1 Sample Labeling**

A consistent sample designation and labeling system will be established and followed to assure easy sample tracking and re-sampling if necessary. Unique combinations of letters and numbers will be used to identify sample locations. It is anticipated that the sample labeling system will be as follows:

For soil samples, the sample label will begin with the letters "SB" to designate a soil boring sample. Each boring location will be numbered sequentially starting with 100 and the boring location will be surveyed and located on a site map. The top of the depth interval will then be designated in each sample label. For example "SB100-10" will represent a soil sample collected from soil boring location 100, at a depth of 10' to 11.5'.

For monitoring well samples, the samples will be labeled with the monitoring well number (MW1, etc.) and the date and time that the sample is collected. Monitoring well locations will likewise be surveyed and located on a site map.

## 2.2 Field Logs

Complete and accurate recordkeeping will be maintained throughout all field activities. The logs will document adherence to work plan activities and procedures. The field information will be recorded in the following documents: Field Logs, Soil boring logs, Sampling forms, Chain of custody forms.

The field logs will detail all observations and measurements made during the Phase I RFI, including:

- personnel on-site
- approximate times of arrival and departure
- log of activities performed
- any relevant observations
- any deviations from the procedures specified in the work plan
- any decisions made in the field and supporting rationale as specified in the work plan
- information regarding calibration of field instruments
- sketches of sample locations or other features of importance

Such information will be recorded directly into the dedicated field notebook, with each entry dated. Each page will be numbered. Any corrections to the entries will be corrected by striking the error so as not to obscure it, entering the correction, and initialing the correction.

For each soil boring, a soil boring log will be completed to document the soil types encountered (USCS classification), depth of water, depth of boring completion, standard penetration blow counts, sample collection intervals, Photo Ionization Detector (PID) measurements and other observations pertinent to the boring (e.g. odor of soils, relative moisture, etc.). For borings where monitoring wells are installed, a well construction diagram will be recorded. The diagram will document the well casing and seen materials, well completion depth, depth and type of filter media, depth of seal, and well completion details. A typical soil boring log and monitoring well construction diagram is provided in Appendix A.

For monitoring well development and sampling, standardized sampling forms will be used to record information such as purge volumes, water characteristics, and results of field instrument readings (e.g. pH, conductivity, etc.). A sample form is provided in Appendix A.

Chain of Custody (C-C) forms will be used to document and track sample possession from the time of collection to the time of sample analysis. The (C-C) forms will detail the number and types of containers for each sample location, the analyses required, and the date and time of sampling. A C-C form will accompany each group of

samples collected. Copies of the completed C-C forms will be provided by the laboratory and filed in the main project files. An example C-C form is provided in Appendix A.

## 2.3 Data Security

The C-C forms will document the security of the samples. Adequate measures to assure that field logs are not altered, damaged or lost will be the direct responsibility of the site supervisor. Access to the field logs will be limited to LTI staff that use them.

## 2.4 Quality Assurance/Quality Control

A separate Quality Assurance Project Plan (QAPP) has been developed for this Phase I RFI. The QAPP specifies procedures for the collection, review, and validation of data produced as part of the Phase I RFI. The QAPP will be followed during all field activities. Any deviation from the procedures contained in the QAPP will be documented in the field logs with supporting rationale.

## 3. Sample Tracking and Management

Sample tracking and management will be performed to assure the security, accuracy, and completeness of the sample analyses. Samples will be shipped by courier to the laboratory and copy of the shipping air bill or receipt will be maintained in the project files. After the samples are submitted to the laboratory for analysis, the laboratory will be contacted by telephone to confirm the receipt and integrity of the samples. The laboratory will be requested to provide written verification of receipt of each sample, with the corresponding laboratory sample identification numbers and analyses to be performed. The following information will then be entered by the Quality Assurance Officer (QAO) into the sample database.

- Sample identification numbers (field and laboratory)
- Sample collection location
- Date and time of sample collection
- Field measurement raw data (if any)
- Date samples were received by laboratory
- Analyses to be performed (and analysis identification number, if available)
- Associated field QA/QC blank identification numbers
- Expected date for laboratory results

When the analytical data are received, The following information shall also be entered into the table by the QAO, or a person designated by the QAO:

- Date that results are received

- Results of analysis

the QAO will review the data to verify that the correct analyses were performed, that labeling of sample identification numbers is accurate, and that the results are complete. Any discrepancies identified will be followed-up immediately by the QAO. The QAO will then conduct a QA/QC review in accordance with the procedures specified in the QAPP. The sample database will then be updated with the following information:

- Date of Preliminary Review
- Date of Data Validation
- Date of Problem Resolution
- Date Validation Completed and Results Finalized

#### **4. Presentation of Data**

All data will be presented in both raw form and in sorted or organized formats. The organized displays will be selected to facilitate data analysis and interpretation. Two major types of displays will be utilized: tabular and graphical.

##### **4.1 Tabular Display**

As required by the RCRA Part B permit, the following data shall be presented in tabular format:

- Unsorted (raw) data
- Results for each medium and for each constituent monitored
- Statistical analysis (if needed)
- Sorted data by potential stratification factors (e.g. location, soil layer, topography)
- Summary of data (if appropriate)

##### **4.2 Graphical Display**

In addition to the tabular presentations, the following data shall be presented in graphical formats (e.g. bar graphs, line graphs, area or plan maps, isopleth plots, cross-sectional plots or transects, three-dimensional graphs, etc.):

- Sampling locations
- Boundaries of sampling area and areas where more data are required (if necessary)
- Chemical concentrations at each sampling location (if present)
- Extent of impacts
- Changes in concentrations in relation to the distance from the source, time, depth, or other parameters, if applicable
- Features affecting intermedia transport including potential receptors, if any.



## **5. Data Management and Document Control**

The data that will be tracked and managed will include hard copies of all correspondence, raw data, C-C forms, sampling forms, survey information, field notes and QA/QC information; computerized site maps showing sampling locations and investigation results; computerized spreadsheets for all validated results; computerized boring logs, geologic profiles and well construction diagrams; and other pertinent information.

LTI will maintain the project files in the Ann Arbor office. The project files will be assigned the project code SKCH1. All hard copies of data will be maintained in a central file system. A directory of all file folders and contents will be developed and maintained. File access records will be maintained by project staff for any files that are temporarily removed from the centralized files. Files will be signed out when accessed for use and then signed back in when returned to the centralized file system. The centralized files will be organized in the following categories: Contractual Information, Work Plan Documents, Correspondence, Permits and Regulatory Requirements, Notes and Data, Previous Investigations and Reports, Project Reports.

All computerized files will be maintained on the LTI personal computer network under a directory labeled SKCH1, with appropriate subdirectories. Backup copies of the computer files are maintained by project staff that create the files. In addition, all LTI computer files are backed up bi-weekly on magnetic tape. All print-outs of computer files will be labeled with the revision number, revision date, file name, and directory containing the file.

Before data are entered into the computer system, the raw data will be QA/QC reviewed in accordance with the QAPP. Any data qualifiers or QA/QC notes will be recorded on the raw data sheets, and measures will be implemented to resolve the issues, as specified in the QAPP. Upon final resolution, if qualifiers remain, they will be carried through-out all subsequent data tables and figures. Data entered into the computer will be checked against the raw data by the scientist entering the data, and then by the senior project engineer or hydrogeologist responsible for collecting the information. Linking of spreadsheets will be maximized to minimize the redundant re-entry of specific data, and thereby minimize the potential for entry errors.

**PHASE I RCRA FACILITY INVESTIGATION  
QUALITY ASSURANCE PROJECT PLAN**

**Safety-Kleen Corporation  
Chicago Recycling Center  
Cook County, Illinois**

Adopted by: \_\_\_\_\_ Date: \_\_\_\_\_

Title: \_\_\_\_\_

Adopted by: \_\_\_\_\_ Date: \_\_\_\_\_

Title: \_\_\_\_\_

*Prepared by:*

**LTI, Limno-Tech, Incorporated  
Ann Arbor, MI**

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## **LIST OF APPENDICES**

- A. Handling, Packing, and Shipping Procedures.
- B. Equipment Cleaning Procedures.
- C. Soil Sampling Procedures.
- D. Monitoring Well/Piezometer Installation Procedures.
- E. Monitoring Well/Piezometer Development Procedures.
- F. Monitoring Well/Piezometer Groundwater Purging and Sampling Procedures.
- G. Monitoring Well/Piezometer Water Level Measurement Procedures.
- H. Work Area Air Monitoring Procedures.
- I. Field Water Quality Measurement Procedures.
- J. In-Situ Hydraulic Conductivity (Slug) Test Procedures.
- K. Laboratory Quality Assurance Manual Synopsis

## **1.0 PROJECT DESCRIPTION**

### **1.1 Introduction**

The purpose of the Quality Assurance Project Plan (QAPP) is to document the necessary procedures required to assure that the project is executed in a manner consistent with applicable United States Environmental Protection Agency (U.S. EPA) guidance documents, Illinois Environmental Protection Agency (IEPA) requirements, and with generally accepted and approved quality assurance objectives. This QAPP was prepared in conjunction with the Work Plan, Health and Safety Plan (HASP), and Data Management Plan for use in conducting the Phase I RCRA Facility Investigation (RFI) activities at the Safety-Kleen Chicago Recycling Center (CRC) in Chicago, Illinois.

This QAPP provides guidance and specifications to assure that:

- Proper preventive maintenance, equipment calibration, and approved analytical protocols will be implemented so that all field measurements and sampling analytical results will be valid;
- Sampling is conducted using sample tracking systems and chain-of-custody procedures which properly identify samples being collected and insure the control of those samples from field collection through analysis and data reduction;
- Records are produced and retained to document the quality of samples collected and analyzed, the validity of applied procedures, and the completeness of the investigation in relation to the approved scope of the project;
- Calculations, evaluations, and decisions completed or deduced during the execution of the study are accurate, appropriate, and consistent with the objectives of this Plan and the Work Plan.

The requirements of this QAPP are applicable to the activities of all participants in the investigation at the CRC. This QAPP will address all anticipated activities necessary to execute the investigation as approved by the IEPA.

### **1.2 Project Objectives**

The RCRA Hazardous Waste Management Part B permit for the CRC establishes the requirements for conducting the RFI. The scope of the RFI as specified in the permit is divided into two phases (Phase I and Phase II). The objective of the Phase I RFI is to confirm that a release has occurred at the CRC solid waste management units (SWMUs). The objective of the Phase II RFI is to define the extent, distribution, and sources of confirmed soil and groundwater impacts associated with the SWMUs. Based upon the results of the RFI, IEPA may require further investigation, implementation of appropriate and feasible interim measures, and/or a corrective measures study as required and as necessary.

As discussed in the Workplan, the Phase I RFI for the CRC provides for the collection of data beyond the scope required by the permit. The scope of the Phase I Workplan is intended to satisfy the objectives of the Phase I RFI as well as provide preliminary information related to the Phase II objectives. Major activities to be undertaken during the course of the Phase I RFI and addressed by this QAPP include the following:

Installation of groundwater monitoring wells and soil borings;

Solid and liquid sample collection, storage, shipment, and control;

Data management activities associated with the compilation, storage, analysis, and presentation of measurements, chemical analyses, and similar data that will be used to determine the nature and extent of the chemical constituents.

The data generated during this investigation will be used for the purpose of determining whether or not a release has occurred, and preliminarily defining the nature, extent, and possible upgradient sources of chemical constituent impacts to the soil and groundwater at the CRC. Description of field activities, sample locations, sampling rationale, assessments to be performed, and the project schedule for this RFI is discussed in detail the Work Plan.

The sampling program consists of collecting soil and groundwater samples from five locations, as presented in Figure 8 of the Phase I Workplan. Soil borings will be drilled into the clay layer that underlies the site to identify the vertical extent of impacts. Samples will be collected using a split spoon sampler, as specified in the Workplan. After the soil borings have been completed, monitoring wells will be installed in the boreholes. The well screens will be five feet long with the top of screen set at a depth of approximately three feet below ground surface. Specifications (well materials, locations, completion depths, etc.) for the installation of the monitoring wells are presented in the Workplan. After the wells are installed and developed, samples will be collected for laboratory analysis. All samples will be analyzed for the constituents listed in the Workplan. Slug tests will be conducted on at least four wells in order to determine bulk hydraulic conductivity in the vicinity of those wells. Samples collected for laboratory analysis will be submitted to GTEL of Wichita, Kansas for analysis according to the U.S. EPA SW-846 methods.

A photo-ionization detector (PID) will be used to monitor total volatile organic compound concentrations in work area air to determine appropriate health and safety protocols for personal protection. The PID will also be used to field screen samples and alert the laboratory, via the chain-of-custody form, of anticipated elevated sample concentrations. Data from the PID will not be used in characterizing the site, as the information is generally unreliable for such purposes.

Additional data collected during the investigation may also include pH, temperature, specific conductance, and turbidity readings associated with the determination of when a well is adequately developed and purged so that representative groundwater samples will be collected.



Reasonable attempts will be made to discuss any field-necessitated changes to the planned sampling program with an IEPA representative prior to implementation.

### 1.3 Reports

At the conclusion of the investigation, a Phase I RFI report will be prepared which presents all data, test results, and findings gathered, and presents conclusions on the nature, extent, and possible upgradient sources associated with soil and groundwater impacts at the site. The report will also present recommendations for further investigations, interim measures, or corrective measures studies as applicable and appropriate.

## 2.0 PROJECT ORGANIZATION AND RESPONSIBILITY

Limno-Tech, Inc. (LTI) of Ann Arbor, Michigan, will maintain the technical responsibility for conducting the Phase I RFI. The analytical laboratory services for this project will be provided by GTEL of Wichita, Kansas. The regulatory agency responsible for final review and approval of work plans and reports submitted for the Phase I RFI is the Illinois Environmental Protection Agency (IEPA).

### 2.1 Limno-Tech, Inc.

Limno-Tech, Inc. (LTI) of Ann Arbor, Michigan, on behalf of Safety-Kleen, will oversee, manage, and conduct the technical aspects of the Phase I RFI. LTI will perform the field investigations, compile the generated data, provide QA/QC oversight, and prepare the Phase I RFI report. The roles and responsibilities of LTI personnel that will work on this project are as follows:

ROLE	PERSONNEL	GENERAL RESPONSIBILITIES
Project Administrator	Paul L. Freedman	General oversight
Project Manager	Gregory W. Peterson	Project management; Review/approval of all work products; Direct all field, quality assurance, data evaluation, and reporting activities
Project Engineer/Scientist	Scott B. Bell Robert J. Betz Joyce S. Dunkin Catherine A. Whiting Jim Richards	Supervise all field sampling, quality assurance, data evaluation, and reporting activities
Assistant Project Engineer/Scientist	Jing Chen Jonathan B. Farr Brian D. Lord John T. Peterson	Field and technical support

### *2.1.1 Project Administrator*

The project administrator is responsible for the overall administration and staffing of the project. As a part of the QA/QC responsibilities, the project administrator will:

- Provide for overall direction of LTI Phase I RFI activities to fulfill the objectives as defined in the Work Plans;
- Provide for QA/QC oversight of all aspects of the project within the responsibility scope of LTI;

### *2.1.2 Project Manager*

The project manager is responsible for maintaining a clear definition of and adherence to the scope, schedule, and budget of the project. As a part of this responsibility, the project manager will:

- Serve as the communication link with Safety-Kleen and the IEPA;
- Direct all work performed by LTI and its subcontractors;
- Approve reports and other materials for release to the IEPA and other external organizations;
- Perform final review of field data reductions, reports submittals, and presentations;
- Assure corrective actions are taken for deficiencies noted during Phase I RFI activities;
- Maintain budgetary and schedule surveillance of the work.

### *2.1.3 Project Engineer/Scientist*

The project engineer/scientist is responsible for the implementation of Phase I RFI field activities, data acquisition, QA/QC protocols and assessment, health and safety aspects of field activities, and for the proper selection and execution of procedures that have been accepted for use in the investigation. As a part of these responsibilities, the project engineer/scientist will:

- Supervise assistant project engineers/scientists, technicians, or subcontractors executing data gathering tasks;
- Supervise the collection of samples so that sampling remains representative of actual field conditions;

- Supervise the regular maintenance of equipment to prevent unnecessary equipment failures and project delays caused thereby;
- Review the effectiveness of procedures and suggest changes that will enhance or more efficiently accomplish the objectives of the Work Plan;
- Review and validate laboratory and field data for consistency with quality assurance objectives;
- Prepare and review field data reductions, reports, submittals, and presentations to assure that data and conclusions accurately reflect observed conditions in the field.
- Assist in the maintenance of budgetary and scheduling surveillance.

#### *2.1.4 Assistant Project Engineer/Scientist*

The assistant project engineer/scientist is responsible for assisting in the implementation of Phase I RFI field activities, data acquisition, health and safety aspects of field activities, and for the proper selection and execution of procedures that have been accepted for use in the investigation. As part of the QA/QC responsibilities, the assistant project engineer/scientist will:

- Perform data gathering and compilation tasks;
- Assist in supervising technicians and subcontractors;
- Assist in reviewing the effectiveness of procedures and suggest changes that will enhance or more efficiently accomplish the objectives of the Work Plan;
- Assist in the collection of samples so that sampling remains representative of actual field conditions;
- Perform regular maintenance and calibration of equipment to prevent unnecessary equipment failures and project delays caused thereby;
- Assist in the preparation and review of field data reductions, reports, submittals, and presentations to assure that data and conclusions accurately reflect observed conditions in the field.

## 2.2 Analytical Laboratory

GTTEL of Wichita, Kansas will conduct all laboratory analyses for this project according to U.S.EPA SW-846 Methods, GTTEL Standard Operating Procedures (SOPs), and the GTTEL Quality Assurance Manual Synopsis (Appendix K of this QAPP). Documentation of all QA/QC procedures consistent with EPA and IEPA requirements will be maintained. Responsibilities and duties of the analytical laboratory include the following:

- Perform analytical procedures;
- Supply sampling containers and shipping cartons;
- Maintain laboratory custody of samples;
- Strictly adhere to all protocols in the QAPP;
- Notify LTI project manager in advance of any deviations to QA protocols.

The project and quality assurance managers for this project at GTTEL will be Martha Ward and John Satler, respectively.

## 2.3 Regulatory Agency

The Illinois Environmental Protection Agency (IEPA) will insure that the Phase I RFI is carried out consistent with the appropriate Federal and State laws and guidelines. Responsibilities and duties of the regulatory agency include the following:

- Review and approval of Work Plans (including the QAPP), reports, and submittals associated with the Phase I RFI;
- Review of Phase I RFI field activities and data for compliance with the QAPP;
- Review of laboratory program, procedures, and results for compliance with the QAPP.

## 3.0 QUALITY ASSURANCE OBJECTIVES

### 3.1 General

The primary quality assurance (QA) objective is to develop and implement procedures for valid and defensible field sampling/measurement, laboratory analysis, and data management activities. The QA characteristics of representativeness, completeness, precision, accuracy, and comparability will govern the determination of whether quality data is generated from field measurements and laboratory analyses during the investigation. Specific objectives for each characteristic are established to develop

sampling protocols and identify applicable documentation, sample handling procedures, and measurement system procedures. These objectives are established based on-site conditions described in the Work Plan and knowledge of available measurement systems. The use of procedures, measurements, and data in field activities, calculations, and evaluations is subject to the conditions of this QAPP as described in the following sections.

### *3.2 Qualitative Quality Assurance Objectives*

#### *3.2.1 Representativeness*

Representativeness is the characteristic that indicates the degree to which sample data accurately and precisely represents site conditions, and is dependent on the variability of sampling and analytical procedures. Proper sampling protocols will be used to assure that samples collected are representative of the media present in the field. Sample handling protocols, including such tasks as storage, transportation, and preservation, will be used to protect the representativeness of the samples gathered during the project. Proper documentation in the field and the laboratory will establish that protocols designed to preserve the representativeness of the samples have been followed and that sample identification and integrity has been preserved.

The Work Plan describes the rationale for sample collection and analyses. Execution of the Work Plan should result in identifying the constituents of concern at the project site.

#### *3.2.2 Comparability*

Comparability is the characteristic that reflects the degree of confidence with which one set of data can be compared to another. The use of consistent sampling and analytical methodologies as presented in this QAPP and the Work Plans will insure that comparability is maintained during the Phase I RFI. Comparability of data collection, measurement, and analysis procedures will also be assessed if data gathered from previous investigations is to be used reliably with data generated from this Phase I RFI.

Split samples can be provided to the regulatory agency, upon request, for independent laboratory analysis. The results from the split analyses could then be compared to provide an assessment of sample handling techniques, analytical methods, and laboratory performance.

Comparison of data sets often indicates that certain values are not consistent with the data as a whole. These values will be evaluated using statistical analysis, if necessary, to determine if the data should be included in the decision-making process.

### *3.3 Quantitative Quality Assurance Objectives*

#### *3.3.1 Precision*

Precision is the characteristic that reflects the ability to replicate a previously obtained value using identical testing procedures. Precision will be measured as the degree of agreement between duplicate analysis results. Precision will be maximized by

using consistent sampling and analytical procedures as established in the QAPP and Work Plans.

Field precision will be evaluated by collecting and analyzing at least one duplicate sample per group of ten samples gathered for analytical evaluation during each sampling event. Since standard sampling procedures will be used, no additional duplicates are required to assess impacts from any changes in sampling team composition. Laboratory precision will be evaluated by analyzing one replicate sample for each group of ten samples of each matrix. Duplicate and replicate samples will be chosen at random.

True duplicates of soil samples are not typically possible because chemical constituents are rarely distributed uniformly in the media, even within small distances in the soil matrix, and discrete grab samples are preferred over composite samples. Discrete duplicate soil samples are more correctly termed co-located samples. This is especially true for samples collected for volatile organic analysis, since mixing is not appropriate and the length of time between collection of the sample from the soil matrix and final capping and sealing of the sample container for shipment must be minimized to prevent volatilization of organics from the sample. Therefore, some differences can be expected from "duplicate" soil samples taken for volatile organic analysis.

The precision of field measurements for all field instrumentation will be assessed by periodically completing duplicate testing of samples in the field at a frequency of one duplicate for every ten samples collected.

Precision of calculations and evaluations performed with the data generated during the project (i.e., the comparability of calculation techniques between various tasks) is assured through review by the project staff.

### *3.3.2 Accuracy*

Accuracy is the characteristic that reflects the degree to which a measured value agrees with the expected or true value associated with the application of concern.

Field data accuracy will be assured through proper calibration of field instruments. Portable field instruments, such as the PID, will be calibrated daily to establish the accuracy of the data collected. The readings obtained with PID will be considered as 100 percent accurate if the instrument is calibrated each day according to procedures described in the appendices and the manufacturers' instructions in the operation manual. Instruments that are factory calibrated will be considered accurate if the most recent calibration occurred within the previous 12-month period and the instrument readings do not appear to be in obvious error.

Laboratory data accuracy will be assessed by using reference standards, matrix spikes, blank spikes, and surrogates as a part of the analytical procedures. The results will be reviewed for compliance with the control limits established for the approved analytical methods.

Accuracy of calculations and evaluations performed with the data generated during the project is assured through review by the project staff.

### *3.3.3 Completeness*

Completeness is the characteristic defined as a measure of the amount of valid data obtained compared to the amount that was specified to be obtained under normal conditions. The amount of valid data specified is established based on the measurements required to accomplish project objectives. The extent of completeness must be reviewed on a relative basis for sample collection activities, since the required amount of valid data anticipated prior to sampling events may not accurately define the amount of data necessary to render a correct decision.

## **4.0 SAMPLING PROCEDURES**

### **4.1 General**

Several standard field procedures will be performed during the Phase I RFI field activities that may include:

- Soil Boring and Sampling;
- Groundwater Monitoring Well Installation;
- Groundwater Sampling; and
- Air Monitoring for Personnel Protection.

The following sections present or reference the detailed methods for performing these activities including related support procedures for equipment cleaning, water level measurements, well development, field water quality measurements, field bulk hydraulic conductivity testing, and calibration and maintenance of field instruments. Sample custody procedures are presented in the Sample Custody Section of this QAPP. For all sampling related procedures, personnel will use personal protective equipment as required in the site HASP.

### **4.2 Cleaning of Equipment and Materials**

All equipment and materials used during the Phase I RFI will be cleaned prior to use at the site and at specified intervals during the RFI. Cleaning will be performed according to the procedures presented in Appendix B to avoid the introduction of any chemical constituents or cross-contamination to the soils or groundwater. Equipment and materials that may be used during the investigation include mechanized and manual drilling equipment, tools, and vehicles; groundwater monitoring well materials; and mechanized and manual soil and groundwater sampling equipment and tools.

Equipment cleaning will be performed using water from a source approved by the project manager or engineer. A designated cleaning or decontamination area will be used or constructed, if necessary, so that all water generated during cleaning operations will be contained for proper disposal.

#### 4.3 Soil Boring and Sampling

Soil borings will be advanced (whenever feasible) using the hollow-stem auger drilling method, as specified in the Work Plan. The detailed procedures for drilling and sampling soil borings are presented in Appendix C. In situations where physical features limit the access and use of drill rigs, borings will be completed with either a hand-driven or a portable power-driven split-spoon sampler, depending upon required depth and material present. Use of any other alternate drilling method for this project will be subject to approval by the regulatory agency.

The hollow-stem auger drilling method does not require the introduction of water or drilling fluids into the borehole, which could compromise the representativeness of samples collected from the boring. For this reason, drilling with hollow-stem augers is preferable to driven casing and rotary drilling methods, which require the use of drilling fluids; air rotary drilling is preferable to wet rotary drilling; and reverse-circulation drilling is preferable to wet rotary drilling. Driven casing and wet rotary drilling methods using clear water and insertion of a temporary flush-joint casing is preferable to recirculation of drilling fluids, and all methods are preferable to wet rotary drilling and the use of bentonite-based drilling muds as a borehole stabilizer. Cable tool methods and other percussion tool drilling methods may be attempted in hard, consolidated formations and with particular consideration being given to the use of procedures that prevent mixing of upper and lower soil zones.

##### *4.3.1 Hollow Stem Auger Drilling and Sampling Procedure*

Soil borings will be drilled with the hollow stem auger method. The detailed procedures for drilling and sampling soil borings are presented in Appendix C. All drilling and sampling equipment and tools will be thoroughly cleaned according to the procedures for cleaning of equipment and materials presented in Appendix B.

The boring will be drilled by successively adding sections of auger until the desired depth is reached. Standard penetration blow counts and samples of the subsurface material will be obtained at regular intervals, not to exceed five feet, as the borehole is advanced. Representative portions of all soil samples will be retained in appropriate containers for visual classification by the supervising geologist and for laboratory analyses, where appropriate and as specified in the Work Plan.

Discrete soil samples will be collected in accordance with ASTM D1586 for split-spoon sampling or ASTM D1587 for thin-walled tube sampling as presented in Appendix C. Soils collected for VOC analysis will be obtained in accordance with IEPA VOC sampling procedures as detailed in Appendix C. Composite soil samples will be avoided unless specified in the Work Plan. Care will be taken to collect samples that are representative of the sampled subsurface formation (avoiding carry-down and heave) and to minimize exposure of samples to air by placing the samples in containers as soon as possible after collection. The procedures for handling, packing, and shipping the samples are presented in Appendix A. Appropriate protective clothing will be worn by all personnel in accordance with the HASP.



Samples will not be collected or stored near a running internal combustion engine or exhaust system. Fumes from such devices could compromise the integrity and representativeness of a sample.

Upon completion of the boring, the auger sections will be removed and, if a monitoring well installation is not specified in the Work Plan, the hole will be backfilled with bentonite and/or a bentonite/portland cement mix. The location will then be marked for future identification. All soil cuttings will be collected, containerized, and stored on-site until arrangements are made for proper disposal.

#### 4.4 Groundwater Monitoring Well Installation

Groundwater monitoring wells will be installed according to the procedures presented in Appendix D. The soil borings will be completed using the soil boring and equipment cleaning procedures presented in Appendices C and B, respectively. The hollow-stem auger method of drilling is preferred. The inside diameter of the augers will be at least 1.33 times the outside diameter of the well materials that will be installed. The well construction materials will be new, clean, and of sound condition. The well material specifications (i.e., construction material, riser and screen diameter and length, screen slot size, protective casing) are presented in the Work Plan.

Upon completion of a borehole to the desired depth, the monitoring well will be installed by placing the screen and casing assembly with bottom plug through the hollow-stem augers. If the bottom of the monitoring well screen is to be set at a depth above the bottom of the borehole, then the borehole will be backfilled with a bentonite grout up to the specified depth for the well bottom. A washed silica sand filter pack will be placed in the annular space surrounding and to at least two feet above the screen. If a sand pack is determined by examination of the native soils to be unnecessary, the auger string will be pulled back to allow the natural aquifer material to collapse around and to at least two feet above the screen. A bentonite slurry seal of at least two feet in thickness will then be added to fill the annular space above the sand pack using a tremie tube. Bentonite pellets or chips may be substituted for the bentonite seal if the well screen is relatively near the water table. The sand pack and bentonite seal will be sounded during installation using a weighted measuring tape to insure that adequate amounts of the material are added. A cement/bentonite grout mixture will then be added to the annulus above the bentonite seal and to within three feet of the surface using a tremie tube during the extraction of the augers.

A protective steel casing (either flush mount or above grade, dependent upon site requirements) will be installed over the well riser and cemented into place so that the cement extends approximately one foot outward from the casing and is sloped to allow water to drain away from the well. The protective steel casing should either be lockable or a locking cap should be placed in the top of the well riser pipe.

The top of the well riser will be marked for use in maintaining consistent groundwater elevation measurements. The elevation of the marked point on the well riser, the ground elevation and the well location will then be surveyed to an existing benchmark using standard instruments and survey techniques.

The supervising geologist/engineer will specify the monitoring well design and materials requirements, as stated in the Work Plans, to the drilling contractor prior to

installation. The supervising geologist/engineer is also responsible for recording in the field notes the actual well construction details and measurements as relayed by the drilling contractor.

#### *4.4.1 Groundwater Monitoring Well Development*

All monitoring wells will be developed according to the detailed procedures in Appendix E to remove fine grained materials that have settled during installation in the well, filter pack, or in the formation materials just outside the filter pack. This process will also help to ensure a good hydraulic connection with the aquifer for the collection of representative groundwater samples. The well will be developed by using surging and water evacuation techniques until the water yield is relatively free of fines. Prior to developing and immediately after the well is opened, the well headspace will be sampled for volatile organic vapors using a PID to determine the need for personal protective clothing and equipment, as described in the HASP.

Surging techniques are usually performed by running a surge block up and down the screened interval to force water out of the well in an effort to loosen and suspend trapped sediments in the water column. A weighted bailer or submersible pump may be substituted for a surge block.

Well development water evacuation techniques may include the use of pumps, bailers, or air lift methods. When using a hand or submersible pump for well evacuation, the pump intake should be moved up and down the length of the screen until the well yields clear water. The use of a centrifugal or suction pump is generally limited to wells with a depth to water not exceeding 25 feet. Where the centrifugal or suction pump is used by connecting the tubing to the top of the riser with air-tight fittings, a surge effect can be created by releasing the air-tight seal at the riser connection to allow the column of water to drop back down the well. Where the nature of the formation and yield does not allow the use of pumps, bailers may be used for well development.

Well development will proceed until the water is clear and free of fines or sediments. Temperature, pH, conductivity, and turbidity will be measured and recorded at regular intervals during well development. Development will then be considered sufficient when these measured parameters have stabilized over a period of at least ten minutes. Procedures for measuring these parameters are presented in Appendix I.

All development water will be collected, containerized, and stored on-site until arrangements are made for proper disposal.

#### *4.5 Groundwater Static Level Measurement, Well Purging, and Sampling*

Groundwater samples will be collected according to the detailed procedures in Appendix F using equipment and sampling devices that have been cleaned according to the procedures described in Appendix B. Prior to collection of a groundwater sample, the well will be thoroughly developed, as described above, according to the procedures presented in Appendix E. In addition, unless the well is sampled directly after well development, the well will be purged in order to obtain a groundwater sample that is representative of the site conditions.

Prior to purging a well, the water level will be allowed to equilibrate in the well for at least 1-2 hours after removal of an unvented well cap. The groundwater static level will then be measured, according to the procedures in Appendix G. The vertical distance from the top of the well casing to the top of the water surface will be measured and recorded as a portion of the well sample data. Electronic water level indicators or a chalked steel measuring tape will be used to collect the static level data.

After the static water level has been determined, the well will be purged of at least three well casing volumes or until the water is clear and free of fines. In the case that the well yield is so low that the well is purged dry, the well will be allowed to recover before collecting samples. Well casing volumes will be calculated and recorded on the field data sheets. All purge water will be collected, containerized, and stored on-site until arrangements are made for proper disposal. If a more quantitative measure of adequate well purging and sample representativeness is required, pH, temperature, and conductivity may be measured and recorded at regular intervals during the purging process. Purging will then be considered sufficient when these measured parameters have stabilized over a period of at least ten minutes. Procedures for measuring these field parameters are presented in Appendix I.

The groundwater samples will be collected using either a low flow pump (e.g., bladder pump) or bailer. If a bailer is used, it will be made of Teflon. Disposable polyethylene bailers may also be used provided that a new bailer is used at each well.

#### 4.6 Air Monitoring for Personnel Protection

Work area air monitoring will be performed during the sampling activities according to the procedures presented in Appendix H. The work area monitoring is intended to protect site workers from volatile organic vapors in the air. Field personnel will monitor volatile organic compounds by using a hand held monitoring instrument. Action levels and protection will be implemented as described in the HASP.

#### 4.7 In-Situ Hydraulic Conductivity (Slug) Testing

Slug tests will be performed as specified in the Workplan to determine the bulk hydraulic conductivity of the silt and fill layers. Additional locations will be tested as time allows. Although field hydraulic conductivity tests of this type are usually performed to determine the conductive properties of a single lithologic layer or unit, tests at the CRC will be conducted on wells even if the wellscreen spans more than one unit (e.g. the well is screened over both the fill and silt layers). Using this approach, the results of the slug test analysis will yield bulk conductivities. This is acceptable since it is likely that the conductivity of the fill material is orders of magnitude greater than that of the silt and recharge of the well will be dominated by flow from the fill.

The slug tests will be conducted using a solid slug or by introducing a volume of compressed air into the covered well. Prior to introducing the slug, a pressure transducer will be lowered into the well to a point near the bottom of the well screen. The lead from the transducer will be connected to a Hermit data logger. When the slug has been introduced into the well and the water level in the well has reached equilibrium, the slug will be rapidly removed. As the water level in the well recovers, the data logger will

record the change in pressure at the transducer. Detailed procedures for conducting the slug tests are described in the Appendix J.

The data will be analyzed using the Bower and Rice method of analysis for slug test data. This method is applicable to partially penetrating wells in unconfined aquifers. Other methods may be employed if site conditions warrant.

## **5.0 SAMPLE AND DOCUMENT CUSTODY**

### **5.1 Field Sample Custody**

The objective of field sample custody is to assure that samples are traceable and are not tampered with between sample collection and receipt by the analytical laboratory. A person will have custody of a sample when the samples are:

- In their physical possession;
- In their view after being in their possession;
- In their personal possession and secured to prevent tampering;
- In a restricted area accessible only to authorized personnel and the person is one of the authorized personnel

Field custody documentation will consist of both field log books and chain of custody forms.

#### **5.1.1 Field Log Books**

Field log books serve as a daily record of events, observations, and measurements during field activities. All information pertinent to sampling activities is recorded in the log books. The log books may be bound with the pages sequentially numbered or include separate sheets for field notes and method specific data logs. (e.g., subsurface logs, water quality logs). These separate logs will be placed in a three-ring binder at the end of the day and numbered sequentially. Entries in the log book will include:

- Name and title of author
- Name(s) of field crew
- Name(s) of site visitors
- Date and time of site entry
- Name of site and project code
- Description of sample location
- Number and volume of samples taken
- Date and time of collection
- Sample identification numbers
- Sampling method
- Preservatives used
- Field measurements (pH, etc.)
- Date and time of shipment
- Shipment method
- Field Observations

#### **5.1.2 Geological Investigation Records**

Subsurface and soil boring sampling logs will be completed on-site to provide a record of information needed to describe the subsurface strata, geotechnical characteristics, and groundwater information from soil sampling will describe lithographic details and will be included in the logs.

#### *5.1.3 Water Sampling Records*

Groundwater and surface water field sampling records will be completed for each sample location and will contain water levels, physical appearance of the water, and field meter readings (temperature, pH, DO, turbidity, and specific conductance), where applicable. Water level readings will be measured to surveyed reference points (e.g., top of outer casing, top of inner casing, ground surface, or a surveyed stake, as appropriate) and recorded on a water level record.

Meters (pH, temperature, conductivity, and turbidity) will be calibrated daily in accordance with Appendix I and the manufacturer's recommendations. Standards, solutions used, concentrations, and readings taken will be recorded daily in field calibration logs.

#### *5.1.4 Air Monitoring and Sampling Records*

The photoionization detector (PID) will be calibrated, as per Appendix H and the manufacturer's recommendations, once after every 10 monitoring wells or borings that are field screened, or daily (whichever occurs first). The PID calibration will be recorded on a field calibration log.

During ambient air sampling, data obtained while the sampler is running will be recorded in the filed notes (logbook) and if applicable, on an air sampling log.

#### *5.1.5 Chain-of-Custody Forms*

Completed chain-of-custody forms will be required for all samples to be analyzed. Chain-of-custody forms will be prepared by the field sampling crew during the sample collection events. The chain-of-custody form will contain the sample's:

- . Unique identification number;
- . Sample date and time;
- . Sample description;
- . Sample type;
- . Sample preservation (if any) and;
- . Analyses required.

The original chain-of-custody form will accompany the samples to the laboratory. Copies will be made prior to shipment for separate field documentation. A chain-of-custody form is included in Appendix A. The chain-of-custody forms will remain with the samples at all times and will be signed by a representative of the laboratory upon receipt of the samples. Copies of the signed forms will be included with the laboratory reports. The samples and signed chain-of-custody form will remain in the possession of the sampling crew until the samples are delivered to the express carrier (e.g., Federal Express).

#### *5.1.6 Sample Packing and Shipping Requirements*

Sample packaging and shipping procedures are designed to ensure that the samples and the chain-of-custody forms will arrive at the laboratory intact and together. Samples will be properly packaged for shipment according to the procedures presented in Appendix A and submitted to the appropriate laboratory for analysis. Shipping containers will be secured with strapping tape and custody seals, if required, for shipment to the laboratory. The preferred procedure includes use of a custody seal attached to the front right and back left of the cooler. The custody seals are covered with clear plastic tape. The cooler is strapped shut with strapping tape in at least two locations.

All shipments will be accompanied by the chain-of-custody form identifying the contents. It is preferred that a separate chain-of-custody form be complete for and placed in each shipping container. The original form will accompany the shipment and copies will be retained by the sampler for the sampling office records.

If sample containers are sent by common carrier (i.e., by Federal Express or United Parcel Service), the carrier need not sign the chain-of-custody form. In such cases, the chain-of-custody form will be sealed inside the sample container. The bill of lading (i.e., Federal Express label) serves as the custody documentation for the shipment so long as the container remains unopened until arrival at the laboratory. Copies of the bill of lading will be retained as part of the permanent documentation of the project.

## **5.2 Laboratory Sample Custody**

### **5.2.1 General**

Laboratory sample custody will be performed in accordance with the laboratory's Quality Assurance Manual Synopsis and will be consistent with the guidelines set forth in this section of the QAPP.

The laboratory must have written standard operating procedures (SOPs) for sample custody including:

- Sample receipt and maintenance of custody;
- Sample storage; and
- Sample tracking.

In addition, the laboratory shall have written SOPs for laboratory safety, cleaning of analytical glass ware, and traceability of standards used in sample analysis QA/QC.

A SOP is defined as a written narrative step-wise description of laboratory operating procedures including examples of laboratory documentation. The SOPs must accurately describe the actual procedures used in the laboratory, and copies of the written SOPs shall be available to the appropriate laboratory personnel. These procedures are necessary to ensure that analytical data produced are acceptable for use. The laboratory SOPs shall provide mechanisms and documentation to meet the specification of the following sections.

#### *5.2.2 Sample Receipt and Maintenance of Custody*

The laboratory shall have a designated sample custodian responsible for receipt of samples and have written SOPs describing duties and responsibilities.

The laboratory shall have written SOPs for receiving and logging in of the samples. The procedures shall include but not be limited to documenting the following information:

- Presence or absence of chain-of-custody forms;
- Presence of absence of bills of lading;
- Presence or absence of custody seals on shipping and/or sample containers and their conditions;
- Presence or absence of sample container labels;
- Sample ID numbers if not recorded on the chain-of-custody record(s) or packing list(s);
- Condition of the shipping container;
- Condition of the sample bottles; and
- Resolution of problems or discrepancies.

#### *5.2.3 Sample Storage*

After samples are received, they are placed in secure storage (e.g., locked refrigerators) where they are maintained at 4° C. Samples to be analyzed for volatile compounds are stored separately to minimize the risk of contamination.

The laboratory shall have written SOPs for maintenance of the security of samples after log-in. The SOPs shall specifically include descriptions of all storage areas for samples in the laboratory, and steps taken to prevent sample contamination. The SOPs shall include a list of authorized personnel who have access or keys to secure storage areas.

#### *5.2.4 Sample Tracking*

The laboratory shall have written SOPs for tracking the work performed on any particular sample. The tracking SOP shall include the following:

- A description of the documentation used to record sample receipt, sample storage, sample transfers, sample preparations, and sample analyses;
- A description of the documentation used to record instrument calibration and other QA/QC activities;
- Examples of the document formats and laboratory documentation used in the sample receipt, sample storage, sample transfer, and sample analyses;

### *5.3 Document Custody*

#### *5.3.1 Laboratory Document Control*

The goal of the Document Control Program is to assure that all documents for a specified project will be accounted for when the project is completed. Laboratory

document control begins with the initial request for proposal and continues throughout the project to include all correspondence, faxed information, and phone logs.

The laboratory shall have written SOPs for organization and assembly of all documents relating to each case, including technical and managerial review. Documents shall be filed on a case-specific basis. The procedures must ensure that all documents including logbook pages, sample tracking records, chromatographic charts, computer printouts, raw data summaries, correspondence, and any other written documents having reference to the case are compiled and stored in one location.

#### *5.3.2 Project File*

Upon completion of the investigation of the site, the final evidence file will be assembled for the project. The final evidence file will contain all pertinent documents and data generated during the course of the investigation. A copy of all data files, log books, and other pertinent documentation generated by the laboratory will be provided to the LTI project manager. All other documents pertaining to the project, such as field logs, chain-of-custody records, correspondence, maps, photographs, and data review reports will be collected and placed in the project file with the laboratory information. The final evidence will be retained in LTI's central files at Ann Arbor, Michigan for at least six years. The laboratory's original copy of all documentation will also be maintained by the laboratory in a secure location for at least six years and be made available to the project manager upon request during that time period.

### **6.0 CALIBRATION PROCEDURES AND FREQUENCY**

#### **6.1 Field Procedures**

Field analytical equipment that may be used in this project include a photoionization detector (PID) and meters for measuring conductivity, pH, temperature, and turbidity. Calibration procedures for the equipment will follow manufacturer instructions and the appendices of this QAPP.

In order to maintain field precision and accuracy, the PID and all water quality meters will be calibrated to known standards. Field analysis and operation procedures, including calibration and sample analysis, are provided in Appendices H (PID) and I, (thermometer, turbidity, conductivity, and pH meters). Calibration frequency and preventive maintenance procedures are also included in these appendices.

#### **6.2 Laboratory Procedures**

Instrument calibration for selected parameters will follow accepted procedures associated with the EPA-SW846, Test Methods for Evaluating Solid Waste, analytical methods. The laboratory's Quality Assurance Manual Synopsis includes a more detailed discussion of calibration and maintenance procedures for laboratory analytical equipment.



## **7.0 ANALYTICAL PROCEDURES**

### **7.1 Field Analytical Procedures**

The field measurement analytical procedures are presented in the appropriate appendices as summarized in Table 7-1 along with the precision, accuracy, and control limits for each parameter.

### **7.2 Laboratory Analytical Procedures**

Laboratory analytical procedures for the samples submitted from the field investigation will be performed consistent to the requirements of EPA SW-846 Test Methods for Evaluating Solid Waste, the American Society for Testing and Materials (ASTM), and the laboratory's Quality Assurance Manual Synopsis. Soil and groundwater samples will be collected, as specified in the Work Plan. Soil sample analytical results will be reported as dry weight and percent solids will be reported separately. Laboratory analytical procedures for the soil and groundwater samples collected are presented in Table 7-2. Required containers, preservation techniques, and holding times are presented in Table 7-3.

## **8.0 DATA REDUCTION, VALIDATION, and REPORTING**

Data obtained from field measurements and laboratory analysis results will be processed as follows:

- Reduction of the data into meaningful and useful forms using mathematical manipulation or other techniques;
- Validation of the data to verify soundness and fitness for use; and
- Reporting of the data in a form that is organized and presentable.

### **8.1 Field Data**

The Project Engineer/Scientist will validate the reduced field data by reviewing field calculations and transcriptions made from the original data sheets. Suspect data will be discussed with the sampler. The field notes and data will be reviewed for:

- Consistency (significant figures, outliers);
- Completeness;
- Readability and interpretation of field notes;
- Field instrument performance (calibration, maintenance);
- Appropriate field procedures; and
- Adherence to work plan.

Final review of field data in report format will be performed by the Project Manager or designee.

## 8.2 Laboratory Data

Laboratory data reduction, validation, and reporting will be performed according to the procedures specified in each of the analysis methods referenced previously in this QAPP and according to the laboratory's Quality Assurance Manual Synopsis. The analytical results will be reported to LTI after being reviewed for completeness and correctness, and including the following information, as applicable:

- Laboratory name and address;
- Field and laboratory sample identification codes;
- Dates of sample receipt, extraction, and analysis;
- Analytical method;
- Sample results;
- Surrogate spike recoveries and control limits;
- Matrix spike/matrix spike duplicate recoveries, relative percent difference, and control limits;
- QC check sample result recoveries, and control limits;
- Duplicate sample results;
- Blank results;
- Internal standard area data (GC/MS); and
- Chain-of-custody forms.

Sample results will be corrected for dilutions and all soil sample results will be reported on a dry weight basis along with percent solids.

The laboratory report data will be reviewed and validated by an LTI Project Engineer/Scientist for the following:

- Completeness of data;
- Proper execution of chain-of-custody forms;
- Compliance with QA/QC guidelines (duplicates, blanks, spikes, holding times);
- Presence of system contaminants or other interferences; and
- Analysis according to methods specified in this QAPP.

Suspect data and deficiencies discovered during the validation process will be discussed with the Project Manager and/or Laboratory Manager for appropriate resolution.

## 9.0 INTERNAL QUALITY CONTROL CHECKS

### 9.1 Field Procedures

The overall quality of field activities (collected samples and field measurements) will be maintained through use of standard field procedures as presented or referenced in this QAPP.

#### 9.1.1 Field Measurements

The accuracy of field measurements will be maintained through calibration of the field instruments according to procedures presented in the Appendices. The precision of field measurements will be assessed through comparison of replicate measurements. Table 7-1 presents the precision and accuracy requirements for field measurements.

#### 9.1.2 Field Duplicates

Blind field duplicates will be collected and analyzed, for soil and water samples, to check the precision or reproducibility of sampling and analytical procedures. Blind field duplicates are defined as two separate samples collected at a single location and labeled with separate identification codes so that the laboratory will not be able to identify the samples as duplicates. The frequency of duplicate collection will be one duplicate per every 10 samples collected. The duplicate samples will be analyzed for the same parameters at the laboratory.

#### 9.1.3 Rinse Blanks

Rinse blanks will be collected and analyzed to check the effectiveness of equipment cleaning procedures. A rinse blank will be prepared by rinsing a cleaned sampling device with analyte-free water (deionized or distilled) and collecting the rinse water in an appropriate sample container. The frequency of rinse blank collection will be one rinse blank per each day that sampling occurs.

#### 9.1.4 Trip Blanks

Trip blanks will be analyzed to check for chemical constituent infiltration originating from sample transport and storage. A trip blank will consist of analyte-free water in a sealed container that remains unopened and accompanies the sample containers in the coolers to and from the site.

Trip blanks will be analyzed for volatile organics and will be analyzed at a frequency of one per every cooler that contains samples for volatile organic analysis.

## 9.2 Laboratory Procedures

Internal laboratory quality control checks will be performed consistent with the required procedures and frequencies of the analytical methods used (EPA SW-846 Test Methods for Evaluating Solid Waste) and the laboratory's Quality Assurance Manual Synopsis. Quality control checks will include, as applicable, analyses of:

- Laboratory duplicates for measurement of analytical precision;
- Method and laboratory blanks for assessment of reagent quality, background from analytical instruments, and analytical variability;
- Method or surrogate spikes for measurement of accuracy;
- Matrix spikes and duplicates for measurement of accuracy and precision;
- Internal and calibration standards for measurement of analytical accuracy; and
- Laboratory control charts to evaluate instrument performance trends.

## 10.0 PERFORMANCE AND SYSTEMS AUDITS

Performance and system audits are conducted to ensure that data of known and defensible qualities are produced during an investigation. A performance audit is a quantitative evaluation of the measurement systems of an investigation that requires testing of a measurement system with samples of known composition to evaluate accuracy and precision. A system audit is a qualitative evaluation of all components of field and laboratory quality control measurement systems to determine if the measurement systems are being used appropriately. System audits can be conducted internally by LTI or externally by the regulatory agency. Deficiencies noted will be reported to the LTI or laboratory Project Manager, as applicable, and appropriate corrective actions taken.

### 10.1 Field Audits

Field performance will be monitored by the Project Engineer through evaluations of field measurements and field instrument calibration to verify that measurements are performed according to established procedures. In addition, rinse and trip blank results will be evaluated to identify potential deficiencies in field sampling, equipment cleaning, and sample handling procedures.

Internal field system audits will be conducted continuously by the field team leader to confirm that appropriate standard operating procedures are being used to conduct the field work according to the Work Plan, QAPP, and/or field sampling plan.

External field system audits will be conducted by IEPA or their oversight contractor, if required.

## 10.2 Laboratory Audits

Laboratory audits will be conducted by the laboratory Quality Assurance Officer according to procedures and frequencies described in the laboratory's Quality Assurance Manual Synopsis. Laboratory performance audits will be performed to evaluate precision and accuracy through comparison of results from duplicate, quality control, spiked, and blank sample analyses.

Internal laboratory system audits will be performed to confirm that daily laboratory activities are conducted according to standard operating procedures for:

- Sample handling;
- Instrument and equipment calibration and maintenance;
- Reagent preparation and handling;
- Analytical methods, controls and standards;
- Data recording, analysis, reporting and archiving; and
- Training, documentation, and personnel qualifications.

External laboratory system audits are conducted by the appropriate regulatory agencies in conjunction with the laboratory's participation in federal and state certification programs.

## 11.0 PREVENTIVE MAINTENANCE

### 11.1 Field Procedures

Field analytical equipment that may be used in this project includes a photomonitorization detector (PID) and meters for measuring temperature, conductivity, pH, and turbidity. Preventive maintenance procedures for the equipment will follow manufacturer instructions. Equipment operation procedures are presented in the appendices and a summary of field instrument preventive maintenance procedures and frequencies are presented in Table 6-1.

### 11.2 Laboratory Procedures

Preventive maintenance of laboratory analytical instruments and other equipment (balances, incubators, refrigerators, analyte free water system, ovens, and building facilities) will follow standard operating procedures at regular intervals consistent with the EPA-SW-845 methods, the laboratory's Quality Assurance Manual Synopsis, and manufacturer's recommended guidelines. In addition, control charts will be maintained for appropriate analytical instruments to evaluate trends in instrument performance that might suggest the necessity for maintenance.

## 12.0 DATA ASSESSMENT FOR ACCURACY, PRECISION, and COMPLETENESS

Data assessment will be performed by both laboratory and field personnel prior to reporting. Accuracy, precision, and completeness will be assessed by LTI and IEPA Quality Assurance staff.

### 12.1 Field Data

Field data will be reviewed by the Project Engineer for compliance with the established QC criteria that are specified in the QAPP. Accuracy of the field measurements will be assessed using daily instrument calibration, calibration check, and analysis of blanks, where applicable. Precision will be assessed by comparing results from replicate measurements of a single sample. Completeness will be evaluated based upon the work done compared with that scheduled in the work plan.

### 12.2 Laboratory Data

Laboratory data will be reviewed by the laboratory QA Manager or designee to assess accuracy, precision, completeness, and compliance with EPA SW-846 QC criteria prior to reporting.

The accuracy of laboratory data will be assessed for compliance with the established QC criteria that are described in EPA SW-846 methods using the analytical results of matrix spike and matrix spike duplicate samples, surrogates, and blanks. The percent recovery (%R) of matrix spike samples will be calculated using the following equation:

$$\%R = \frac{A - B}{C} \times 100$$

Where:

- A = The analyte concentration determined experimentally from the spiked sample.
- B = The background level determined by a separate analysis of the unspiked sample.
- C = The amount of the spike added.

The precision of laboratory data will be assessed by comparing matrix spike and matrix spike duplicate (MS/MSD) results for organic analyses, laboratory duplicate results for inorganic analysis, and field duplicate results for all analyses. The relative percent difference (%RPD) will be calculated for each pair of duplicate results using the following equation:

$$\%RPD = \frac{S - D}{(S + D)/2} \times 100$$

Where:

S = First Sample value (initial or MS value); and  
D = Second sample value (duplicate or MSD value).

The completeness of the data set will be assessed according to the amount of valid data obtained compared with that planned or expected. The completeness is calculated using the following equation.

$$\text{Completeness} = \frac{\text{Valid Data Obtained}}{\text{Total Data Planned}} \times 100.$$

### 13.0 CORRECTIVE ACTION

Corrective action procedures for field and laboratory activities are followed whenever a system is out of control to assure that data quality is maintained during the investigation. Corrective actions include procedures to promptly investigate, document, evaluate, and correct any deficiencies in data quality.

If a condition is noted to have an adverse effect on data quality, corrective action will be taken to eliminate the reoccurrence of this condition. Condition identification, cause, and corrective action implemented will be documented and reported to the Project Manager.

Project and laboratory personnel will continuously monitor ongoing work performance in the normal course of daily responsibilities.

Examples of situations that would require corrective action include the following:

- Standard operating procedures have not been properly performed;
- Pre-determined data acceptance standards are not maintained;
- Equipment and instrumentation is not in proper working order or properly calibrated;
- Samples and analytical results are not completely traceable;
- QC requirements are not met;
- Improper approvals; or
- Deficiencies are discovered during system or performance audits.

Corrective action may include:

- Resampling and/or reanalyzing the samples;
- Evaluating and amending sampling procedures;
- Evaluating and amending analytical procedures; or
- Accepting data and acknowledging the level of uncertainty.

Additional description of corrective action procedures for the laboratory will be found in its Quality Assurance Manual Synopsis.

#### **14.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT**

Periodic summary reports will be prepared by the Project Engineer in charge of Quality Assurance if necessary, to inform the LTI Project Manager of the project status. The reports will include:

- Periodic assessment of measurement data accuracy, precision, and completeness;
- Results of performance audits and/or systems audits;
- Significant Quality Assurance/Quality Control problems and recommended corrective action;
- Status of corrective action implementation to any problems previously identified.



**TABLE 6-1**  
**Field Equipment**  
**Calibration Frequency and Preventative Maintenance**

Maintenance	Frequency
<b>PHOTOIONIZATION DETECTOR</b>	
store in protective casing inspect equipment after use check and recharge batteries clean UV lamp window keep log book on instrument have replacement meter available return to manufacturer for service calibration	daily daily daily after 24 hours use or operator discretion daily operator discretion operator discretion after ten analyses or daily
<b>THERMOMETER</b>	
store in protective casing inspect equipment after use have a replacement thermometer available	daily daily operator discretion
<b>TURBIDIMETER (NEPHELOMETER)</b>	
store in protective casing inspect equipment after use clean sample tubes clean sample chamber check and recharge batteries keep log book on instrument have replacement meter available return to manufacturer for service calibration	daily daily daily operator discretion daily daily operator discretion operator discretion daily or operator discretion
<b>CONDUCTIVITY and pH METERS</b>	
store in protective casing inspect equipment after use check and recharge/replace batteries clean probe keep log book on instrument have replacement meter available replace probes return to manufacturer for service calibration	daily daily daily after each use daily operator discretion operator discretion operator discretion daily or per manufacturer recommendation

TABLE 7-1

Field Measurement Analytical Procedures

Field Parameter	Appendix	Matrix Analyzed	Precision	Accuracy
Temperature	I	Water/Air	$\pm 1^{\circ}\text{C}$	$\pm 1^{\circ}\text{C}$
pH	I	Water	$\pm 0.1$ pH units	$\pm 2\%$ pH units
Conductivity	I	Water	$\pm 0.01$ mS/cm	$\pm 5\%$ of full scale
Turbidity	I	Water	$\pm 1.0$ NTU	$\pm 2\%$ or $0.05$ NTU, whichever is greater
Photoionization Detector	H	Air	$\pm 0.1$ ppm isobutylene	$\pm 10\%$

**TABLE 7-2**  
**Laboratory Analytical Parameters**  
**for**  
**Soil and Water Samples**

<b>Parameter</b>	<b>SW-846 Method</b>	<b>Analysis Type</b>
<b>Volatle Organics</b>		
Chloroform	8240	GC/MS
Chloroethane	8240	GC/MS
1,1-Dichloroethane	8240	GC/MS
1,2-Dichloroethene(total)	8240	GC/MS
Methylene chloride	8240	GC/MS
Tetrachloroethene	8240	GC/MS
1,1,1-Trichloroethane	8240	GC/MS
Trichloroethene	8240	GC/MS
Trichlorotrifluoroethane	8240	GC/MS
Tetrahydrofuran	8240	GC/MS
Toluene	8240	GC/MS
<b>Semi-Volatile Organics</b>		
1-Methyl-2-pyrrolidinone	8270	GC/MS
β-Picoline	8270	GC/MS
Pyridine	8270	GC/MS

**TABLE 7-3**

**Sample Container, Preservation Technique, and Holding Time Requirements**  
**for**  
**Water Samples**

Parameter	SW-846 Method	Sample Container	Sample Volume	Sample Preservation	Holding Time*
<b>Volatile Organics</b>	8240	4 oz. CWM	100 grams	4 ° C	14 days
	8240	40 ml GV	120 ml	4 drops HCL, 4 ° C	14 days
	8270	16 oz. AWM	100 grams	4 ° C	14 ext./40 days aft ex
<b>Semi-Volatile Organics</b>	8270	AG liter	2 liters	4 ° C	7 ext./40 days aft ext.

\* from date of sample collection

CWM clear wide mouth glass jar with Teflon lined cap

AWM amber wide mouth glass jar with Teflon lined cap

GV glass vial with Teflon septum

AG amber glass with Teflon septum

**APPENDIX A**  
**HANDLING, PACKING AND SHIPPING PROCEDURES**

## **I. Handling**

1. Fill in sample label (Attachment A-1). Use indelible waterproof marking pen and include:
  - Sample Identification code (if possible, should reflect site name, sample location and sample interval)
  - Sample type (e.g., soil, sediment, water);
  - Project code;
  - Analysis required;
  - Date sampled;
  - Time sampled;
  - Name or initials of person who collected the sample;
  - Mode of collection (composite or grab); and
  - Preservation added, if applicable.
2. Check the caps on the sample containers so that they are tightly sealed.
3. Cover the label and sample container cap with clear packing tape to secure the label and cap onto the container, if necessary.
4. Place a signed custody seal label (Attachment A-2) over the cap such that the cap cannot be removed without breaking the custody seal, if required.
5. For VOA vials, rap the seal around the vial and cap so as not to cover the septum in the top of the cap. (Sealant tape may contain constituents, (e.g., toluene) that could permeate the septum and contaminate the sample.)

## **II. Packing**

1. If using a laboratory supplied transpack, follow the laboratory's instructions for packing. Generally, repack the transpack in the same way in which the empty containers were received. If using a standard cooler, follow the instructions below.
2. Using packaging tape, secure the outside and inside the drain plug at the bottom of the cooler that is used for sample transport.
3. Place 1 to 2 inches of vermiculite or other cushioning material at the bottom of the cooler.
4. Place the sealed container upright in the cooler.

5. Place additional cushioning material around the sides of each sample container.
6. Place frozen gel cold packs on top of sample containers. If ice is used, repack ice in small Ziploc<sup>®</sup> - type plastic bags and place loosely in the cooler. Do not pack cold packs or ice so tightly that it may prevent the addition of sufficient cushioning material.
7. Fill the remaining space in the cooler with vermiculite or other cushioning material.
8. Place the chain-of-custody forms (Attachment A-3) in a large Ziploc<sup>®</sup> type bag and tape the forms to the inside of the cooler lid.
9. Close the cooler lid and fasten with packaging tape.
10. Wrap strapping or packaging tape around both ends of the cooler at least twice.
11. Mark the cooler on the outside with the following information: return address, "Fragile" labels (Attachment A-4) on the top and on one side, and arrows indicating "This Side Up" (Attachment A-4) on two adjacent sides.
12. Place custody seal evidence tape (Attachment A-4) over front right and back left of the cooler lid and cover with clear plastic tape.

### **III. Shipping**

1. Environmental samples will be shipped according to 40 CFR 761.65 (i)(3) and in accordance with current and applicable D.O standards.
2. All samples will be delivered by an express carrier, allowing for sufficient time for analysis to be performed within the holding time periods specified in Table 4-1.
3. The following chain-of-custody procedures will apply to sample shipping:
  - Relinquish the sample containers to the laboratory via express carrier. The signed and dated forms should be taped inside the top of the cooler. The express carrier will not be required to sign the chain-of-custody forms.
  - When the samples are received by the laboratory, the laboratory personnel shall complete the chain-of-custody forms by signing and dating to acknowledge receipt of samples. The internal temperature of the shipping container is measured and recorded. The sample identification numbers on the containers are then checked to insure that they are consistent with the chain of custody forms.

**ATTACHMENT A-1 (TO APPENDIX A)  
SAMPLE LABEL**



The COC and all other forms used to document the proper handling of the samples contain a location(s) for appropriate signatures. All individuals who have custody of the sample are required to sign the forms in black ink and date the entry. The original field COC is not written upon by GTEL, except in the lab use only sections. All errors on GTEL's internal custody documentation are corrected by drawing one line through the error and initialing and dating the error.

Date: \_\_\_\_\_ Time: \_\_\_\_\_

Job#: \_\_\_\_\_

Sampler: \_\_\_\_\_

COC#: \_\_\_\_\_ Sample ID: \_\_\_\_\_

Analysis: \_\_\_\_\_

Sample Label

**ATTACHMENT A-2 (TO APPENDIX A)  
CUSTODY SEAL LABEL**

**CUSTODY SEAL**

DATE \_\_\_\_\_

SIGNATURE \_\_\_\_\_



(800) 443-1639

(800) 553-3636

Specialty Cleaned Containers

**ATTACHMENT A-3 (TO APPENDIX A)  
CHAIN-OF-CUSTODY FORM**



### Chain-of-Custody Instructions

GTEL provides sample labels and Chain-of-Custody (COC)/analysis request forms for use by clients. All labeled samples are to be submitted accompanied by a COC form. The laboratory will perform the analysis as requested on the COC.

The following are step-by-step instructions for completing our custody and analysis request form.

1. **Company Name:** Enter the name of the consultant.
2. **Phone #/Fax #:** Enter the phone number where the project manager, or person who should be contacted, can be reached.
3. **Address:** Enter the address of the project manager or the address of the person who should receive the report.
4. **Site Location:** Enter the city and state where samples were collected.
5. **Project Manager:** Print the name of the project manager or the name of the person who should receive the report.
6. **Client Project ID #/Name:** Enter your project number and name.
7. **Sampler Name:** Print sampler's name and the sampler should initial the statement regarding field sampling procedures.
8. **Field Sample ID:** Enter one sample ID per line. Print the ID which will identify the samples on the sample label and in the report. The ID must be limited to 8 characters.
9. **GTEL Sample #:** For Lab Use Only. Do Not Write in This Space.
10. **Number of Containers:** Enter the total number of containers for the sample ID listed on the same line. See sample COC for example.
11. **Matrix:** Put a check in one of these boxes to describe the sample matrix. If the matrix is "Other" please specify in the remarks section.
12. **Method Preserved:** Put the number of containers in the box which describes the type of preservation used. If ice is used, put a check in that box. Describe "Other" types of preservation in the Remarks section.
13. **Sampling:** Enter the date (month, day, year) and time (military) of sample collection.
14. **Analysis Request:** Put a check in the box on the same line as field ID to request analysis. More than one analysis request can be made per line by including all of the different container types, per field ID, on one line. Choose a method by putting a check in the boxes opposite the method descriptors. Contact a GTEL CSR if you have any questions regarding the type of method to choose.
15. **Other:** Enter analytical method number and other descriptors to describe the type of analysis needed. For example, to request for Total Organic Halogen (TOX) enter TOX under "Other". Contact customer service to schedule special analysis requests.

16. **TAT:** Indicate Turnaround Time (TAT) preference.
17. **Special Handling:** Request special handling of the analysis and report by putting a check in the appropriate boxes. If you have been given a Safety-Kleen authorization number, it should appear in this section.
18. **Special Detection Limits:** Please specify special detection limits if they are required. For example, if your sample is from a municipal water supply, it is important to specify drinking water detection limits.
19. **Special Reporting Requirements:** Please specify special reporting requirements if there are any required.
20. **Remarks:** Any pertinent information regarding samples, analysis request, or special handling must be noted here. Samples which are known to be highly contaminated can be noted in this section. Project ID should be specified in this section (site location, site number, code, etc.). If provided, this information will appear on every page of the report. If it is not specified, "Not Provided" will appear.
21. **For lab use only.**
22. **Relinquished by:** To be signed, dated, and time entered by the sampler at the time the samples are relinquished to the carrier for shipment, or other authorized person.
23. **Received by/Relinquished by:** To be signed by each person involved in the transfer of custody.
24. **Received by laboratory:** To be signed by laboratory login staff at the time of sample receipt. The shipping waybill number will be entered in this box also at the time of receipt.

**APPENDIX B**  
**EQUIPMENT CLEANING PROCEDURES**



## **I. Introduction**

Equipment cleaning areas will be located within or adjacent to a specific work area or as specified in the Health and Safety Plan. The equipment cleaning procedures described in this document include pre-field, in-field, and post-field cleaning of sampling equipment. The sampling equipment consists of soil/sampling equipment, well construction materials, ground-water sampling devices, water testing instruments, and other activity-specific sampling equipment. All non-disposable sampling equipment will be cleaned after completion of each sampling event. Cleaning procedures will be monitored through the analysis of check samples as described in Section 9 (Internal Quality Control Checks) of this QAPP.

## **II. Materials**

The following materials will be available during equipment cleaning, as needed:

- Personal protection equipment (as required in the Health and Safety Plan);
- Distilled/deionized water;
- Non-phosphate detergent (alconox, Liquinox, or equivalent);
- Tap water;
- Appropriate cleaning solvent (e.g., methanol);
- Nitric acid;
- High-pressure hot water/steam cleaning unit;
- Wash basins;
- Brushes;
- Polyethylene sheeting;
- Aluminum foil;
- Plastic overpack drum, garbage can, or stainless steel tubes (for bladder pump);
- Large heavy-duty garbage bags;

- Spray bottles (to hold tap water, distilled/deionized water, methanol, or nitric acid); and

- Disposable (PVC, latex or nitrile) gloves.

### **III. Storage of Equipment**

All cleaned sampling equipment will be stored in a clean environment and, where appropriate, the equipment will be covered/sealed with aluminum foil.

### **IV. Safety Procedures During Equipment Cleaning**

1. Personnel will wear the following personal protection equipment at a minimum, when cleaning sampling equipment (e.g., split-spoon sampler, trowels) and larger equipment (e.g., drill rig, augers):

- Safety glasses, goggles, or a splash shield; and

- PVC, latex, or nitrile outer gloves,

- Coated Tyvek® disposable coveralls or rainsuit, optional for small equipment cleaning; and

- Chemical resistant over boots, optional for small equipment cleaning.

2. All solvent rinsing if required, will be conducted in an adequately ventilated area.
3. All solvents transported into the field will be stored and packaged in appropriate containers with care taken to avoid exposure to extreme heat.
4. Handling of solvents will be consistent with the manufacturer's Material Safety Data Sheets (MSDS).

### **V. Field Cleaning Procedures**

#### **A. Cleaning Station**

A designated field equipment cleaning station location will be established to conduct all cleaning at each work area of the Site. The field equipment cleaning station will be located away from the immediate work area to minimize adverse impacts from work activities on the cleaning procedures, but close enough so the sampling teams can minimize equipment handling and transport. All heavy equipment such as drill rigs and backhoes will receive an initial cleaning prior to use at the Site. The frequency of

subsequent cleaning will depend on the amount of use the heavy equipment receives and the extent of exposure to dirt and contaminants during the sampling event.

#### **B. Cleaning of Smaller Sampling Equipment**

Cleaning of smaller sampling equipment (e.g., split-spoon samplers, bailers, trowels) will be conducted according to the following sequential procedure:

Non-phosphate detergent (Alconox, Liquinox, or equivalent) and tap water wash;

Tap water rinse;

Solvent rinse, if required (e.g., methanol for organic constituent analysis, nitric acid for inorganic constituent analysis); and

Triple distilled/deionized water rinse.

The first step, non-phosphate detergent and tap water scrub, is intended to remove all visible particulate matter and residual oil and grease. This may be preceded by a steam cleaning to facilitate soils removal. The tap water rinse is necessary to remove all soapy residue. The need for a specific solvent used for the solvent rinse, if required in the work plan or QAPP, will depend upon what the sample will be analyzed for. The final rinse of distilled/deionized water will be repeated three times. The equipment will then be allowed to air dry.

#### **C. Cleaning of Submersible Pumps**

Submersible pumps may be used to evacuate stagnant groundwater from the well casing (e.g., air lift or turbine pumps) or to collect samples (e.g., bladder pump). The pumps will be cleaned and flushed between using an external detergent wash and tap water rinse. Steam cleaning may be substituted of pump casing, hose, and cables followed by a flushing with potable water through the pump. The flushing process for development and purge pumps may be performed by pumping potable water from a clean plastic overpack drum or plastic garbage can until a sufficient amount of water has flushed the system. The flushing process for sampling pumps will consist of filling each of three stainless steel tubes ( 5 feet long by 6 inches' diameter) with detergent water, tap water, and deionized/distilled water, placing the sampling pump into each tube, respectively, and pumping sufficient liquid from each chamber through the pump chamber and hose. If electric power pumps are used, care should be taken to avoid contact with the pump casing and water in the drum while the pump is running to avoid electric shock. The pump and hose will be placed on clean polyethylene sheeting to avoid contact with the ground surface.

#### **D. Cleaning of Heavy Equipment**

Other equipment and materials, such as drill rigs, well casings, tools, and auger flights, associated with sampling events, will be cleaned prior to use. This equipment may retain chemical constituents from sources unrelated to the sampling site such as roadways, storage areas, or material from previous job sites that were not adequately removed. Heavy equipment will be thoroughly steam cleaned and/or manually scrubbed and rinsed upon arrival on site and when moved between sampling locations. Drill rig items such as auger flights, wrenches, drill rods, and drill bits will also be cleaned before changing sample locations.

#### **E. Collection and Disposal of used Solvents, Residuals and Rinse Solutions**

All solvents, residuals, and rinse waters generated during the cleaning of equipment on-site will be collected, containerized, and stored on-site until arrangements can be made for proper disposal.

**APPENDIX C**  
**SOIL SAMPLING PROCEDURES**

## **I. Surface/Shallow Soil Sampling**

### **Introduction**

Surface and shallow soil samples will be collected using a hand-driven split-spoon sampler or Shelby tube, a stainless steel bucket auger, or a trowel and scoop as determined by the field supervisor depending on the subsurface material. Hand borings will be performed in areas where truck-mounted rigs are unable to gain access. Samples of subsurface material encountered during this operation will be collected at predetermined depth intervals for soils, sediments, and remnant deposit materials, if encountered and as specified in the work plan.

### **Materials**

The following materials, as required, will be available during surface/shallow soil sampling:

- Personal protective equipment as required by the Health and Safety Plan;
- Cleaning equipment as required in Appendix B;
- Aluminum foil;
- Field log;
- Appropriate sample containers and forms;
- Insulated coolers with coil packs or ice;
- Concrete saws, or coring devices;
- Stainless steel split-spoon sampler or Shelby tube;
- Stainless steel bucket auger;
- Sampling device extension rods, handle or hammer-driver;
- Stainless steel scoop trowel;
- Stainless steel spatula lab spoon, or equivalent (new wooden tongue depressors may also be used); and
- Six inch brass lined samplers

### **Procedures**

The following procedures will be employed to collect surface/shallow samples:

1. Don personal protective equipment as required by the Health and Safety Plan.

2. For surface/near surface soil sampling:
    - a. Carefully remove the top layer of soil to the specified depth, if required, using a pre cleaned stainless steel scoop or trowel.
    - b. Remove and discard a thin layer of soil from where the sample will be collected using a clean stainless steel scoop or trowel.
    - c. Carefully remove the desired representative sample with a precleaned stainless steel spatula, labspoon or equivalent.
  3. For shallow subsurface soil sampling:
    - a. Hand bore down to the specified depth using a precleaned bucket auger.
    - b. Carefully insert a precleaned stainless steel split spoon sampler, shelly tube, or bucket auger to the bottom of the borehole and drive into the soil in a straight and vertical manner to secure a reasonably representative sample.
    - c. Remove the sampler and place on a piece of aluminum foil to avoid contact with surrounding soils.
    - d. Remove all excess soil from the outside of the sampling device to avoid cross contamination over the sample depth.
    - e. Discard the upper 1"-2" of soil in the sampling device to avoid including borehole cave-in or carry down with the sample.
  4. Place the sample in the appropriate sample container.
  5. Record all appropriate information in the field log.
  6. Label, handle, pack, and ship the samples consistent with the procedures in Appendix A.
  7. Fill the sampling hole with the discarded soils, or grout the hole with bentonite, or bentonite/portland cement grout.
- If soils are to be obtained for volatile analysis, a six inch brass sample tube should be used and the following procedures, in accordance with IEPA Soil Volatile Sampling Procedures, should be followed:
1. Prepare and decontaminate the six inch brass liner and soil sampler in accordance with IEPA Soil Volatile Sampling Procedures, as follows:
    - a. Wash tubing or sampler with hot water and a non-foaming detergent.
    - b. Rinse with hot water.
    - c. Rinse with a solvent, such as hexane or acetone.

- d. Rinse with very hot water to drive off solvent.
  - e. Rinse with deionized or distilled water.
  - f. Air dry.
  - g. Store the sampler in aluminum foil until ready for use.
2. Sample as follows:
- a. Using a properly decontaminated sampler (refer to preparation and decontamination instructions), push or drive the sampler to obtain a representative soil sample.
  - b. DO NOT remove sample from the sample tube in the field. The laboratory should remove the sample from the sample tube.
  - c. Immediately add clay or other cohesive material (i.e. wetted bentonite) to the ends of the sample to eliminate head space, if necessary.
  - d. Cover both ends of the sampler with aluminum foil. If possible, cover the aluminum foil with a cap.
  - e. Put the sampler in storage at 4 degrees centigrade immediately.
  - f. Transport the samples to the laboratory as soon as possible.

NOTE: Soil samples which will be tested for volatile organic compounds cannot be composited because of the volatilization which would result from any composting method.

## **II. Soil Boring Sampling**

### **Introduction**

Soil borings will be completed using the hollow-stem auger drilling method to a depth specified by the supervising geologist/engineer. In situations where physical site features limit the use of drill rigs, soil borings will be completed with a hand driven auger, a portable power auger, or a tripod and split-barrel sampler (split-spoon) depending on the required depth and subsurface material.

Samples of subsurface material encountered during the drilling of soil borings will be collected at regular intervals, not to exceed five feet, to the required depth of the boring, or as directed by the supervising geologist. The sampling method employed will be American Society of Testing and Materials (ASTM) D1586 - Standard Method for Penetration Test and Split-Barrel Sampling of Soils or ASTM D4700 - Soil Sampling from the Vadose Zone. Relatively undisturbed samples will be collected for geotechnical evaluation, if required, using ASTM D1587 - Thin-walled Tube Sampling of Soils or ASTM D4700. If sampling soils for volatile organic compound analysis, the IEPA VOC sampling procedures will be employed. Six inch brass samplers will be used to obtain the samples.



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Upon completion of the boring, if a monitoring well is not to be installed, the bore hole will be grouted in the surface with bentonite or bentonite/cement grout and the surface will be restored.

#### Materials

The following materials shall be available during soil boring sampling:

- Personal protective equipment as required by the Health and Safety Plan;
- Cleaning equipment as required in Appendix B;
- Precleaned drill rig, drill rods, auger flights, and samplers;
- Appropriate sample containers and forms;
- Six inch brass liners for split spoon sampler;
- Insulated coolers with ice;
- Dot approved drums for the containerization of soil cuttings; and
- Field log.

#### Procedures

1. Soil samples will be taken at 5 foot intervals or as required to provide a profile of the subsurface. A geologist will be on-site during the drilling operations to fully describe each soil sample and drill cuttings including:

- soil type;
- color;
- percent recovery;
- relative moisture content;
- texture;
- grain size and shape;
- consistency;
- standard penetration blow counts;
- depth to water tables; and
- any other noteworthy observations.

The descriptions will be recorded on a subsurface log (Attachment C-1).

2. Upon retrieval of split-spoon samples, representative portions of the bottom 1.5-foot depth increment from each sample (unless modified by site-specific conditions), will be placed in appropriate sample containers.
3. For samples collected for VOC analysis, the samples will be collected in accordance with IEPA procedures as follows:
  1. Prepare and decontaminate the six inch brass liner and soil sampler in accordance with IEPA Soil Volatile Sampling Procedures, as follows:
    - a. Wash tubing or sampler with hot water and a non-foaming detergent.
    - b. Rinse with hot water.
    - c. Rinse with a solvent, such as hexane or acetone.
    - d. Rinse with very hot water to drive off solvent.
    - e. Rinse with deionized or distilled water.
    - f. Air dry.
    - g. Store the sampler in aluminum foil until ready for use.
  2. Sample as follows:
    - a. Using a properly decontaminated sampler (refer to preparation and decontamination instructions), push or drive the sampler to obtain a representative soil sample.
    - b. DO NOT remove sample from the sample tube in the field. The laboratory should remove the sample from the sample tube.
    - c. Immediately add clay or other cohesive material (i.e. wetted bentonite) to the ends of the sample to eliminate head space, if necessary.
    - d. Cover both ends of the sampler with aluminum foil. If possible, cover the aluminum foil with a cap.
    - e. Put the sampler in storage at 4 degrees centigrade immediately.
    - f. Transport the samples to the laboratory as soon as possible.

NOTE: Soil samples which will be tested for volatile organic compounds cannot be composited because of the volatilization which would result from any composting method.

4. If required, one representative portion of each sample will be placed in a clean jar, covered with aluminum foil, and let stand for several minutes. The head space will then be screened with a photoionization detector (PID) or equivalent field instrument

and the relative concentration of total volatile organic compounds (VOCs) in the sample will be recorded on the boring log.

5. Sample containers will be labeled, temporarily stored on site, and transported to the appropriate testing laboratory at the end of the day, whenever possible. The samples will be handled, packed, and shipped in accordance with the procedures set forth in Appendix A.
6. The supervising geologist will be responsible for documenting drilling events in the field log.
7. The drilling contractor will be responsible for obtaining accurate and representative samples and informing the supervising geologist of changes in drilling pressure and keeping a separate subsurface log of soils encountered, including blow counts [i.e., the number of blows form a soil sampling drive weight (140 pounds) required to drive the split-spoon sampler in 6-inch increments].

### **III. Survey**

A field survey control program will be conducted, if required, using standard instrument survey techniques to document the boring or surficial soil sampling location and elevation.

### **IV. Equipment Cleaning**

Equipment cleaning will be performed at the beginning of the sampling event and between each separate sampling location as described in Appendix B.

### **V. Disposal Methods**

All water generated during cleaning procedures will be collected and contained on site for determination of appropriate treatment/disposal methods.

Personal protective equipment, such as gloves, disposable clothing, and the disposable equipment resulting from personnel cleaning procedures and soil sampling and handling activities will be placed in plastic bags. These bags will be transferred into appropriately labeled 55-gallon drums for appropriate disposal as necessary.

Soil cuttings will be placed in sealed 55-gallon steel drums or roll-off boxes and stored in a secured area. Once full, the material will be analyzed to determine appropriate disposal methods.

**ATTACHMENT C-1 (TO APPENDIX C)  
SUBSURFACE LOG**

## LIMNO-TECH, INC. SUBSURFACE LOG

[illegible]

**APPENDIX D**  
**MONITORING WELL/PIEZOMETER INSTALLATION PROCEDURES**

## **I. Introduction**

Soil borings, which will be completed as monitoring wells, will be advanced using the hollow-stem auger drilling method. No oils or grease will be used on equipment in the boreholes (e.g., drill rod, casing, sampling tools). Wells will be installed using clean well materials (and equipment) specified in the Work Plan. The supervising geologist/engineer will specify the monitoring well design and materials requirements as specified in the Work Plan, to the drilling contractor prior to installation.

## **II. Procedures for Monitoring Well Installation**

Upon completion of a borehole to the desired depth, the monitoring well will be installed by placing the screen, riser, and bottom plug assembly through the auger column. The screened interval of the monitoring well will be as specified in the Work Plan, with general care being taken to avoid including hydraulically separate zones within the same screened interval. A washed silica sand filter pack will be placed in the annular space adjacent to the screen to at least two feet above the top of the screen. If a sand pack is not specified, the auger string will be pulled back to allow the natural aquifer material to collapse to a minimum of two feet above the top of the screen. A bentonite slurry seal of at least two feet in thickness will then be added to fill the annular space above the sand pack using a tremie tube. Bentonite pellets or chips may be substituted for the bentonite slurry if the well screen is relatively near the water table and bridging problems can be avoided. The sand pack and bentonite seal materials will be frequently sounded during installation using a weighted measuring tape to ensure that sufficient quantities of material have been added. A cement/bentonite grout mixture will then be added to the annulus above the bentonite seal and to within three feet of the surface using a tremie tube during the extraction of the augers.

A protective locking steel casing either flushmount or above grade, dependent upon site requirements, will be installed over the well riser. Above grade casings will be preferentially used when not precluded by traffic restrictions. The protective casings will be cemented into place using redi-mix concrete, so that the cement extends approximately one foot out from the casing and is sloped to allow water to drain away from the well. The protective steel casing should either be lockable or a locking cap should be placed in the top of the well riser pipe.

A diagram of a typical monitoring well construction is shown as Attachment D-1.

The supervising geologist/engineer is responsible for recording in the field notes the exact well construction details and measurements as relayed by the drilling contractor. Both the supervising geologist/engineer and drilling contractor are responsible for tabulating all well materials used, such as type and length of casing and screen, and bags of bentonite, cement, and sand.

### **III. Procedures for Piezometer Installation**

Piezometers will be installed using drilling methods (as described in Appendix C) or using hand-driven methods (where drilling is not possible). The piezometer construction material will consist of porous plastic or ceramic piezometer tips with 12 to 25 mm internal diameter stainless steel or PVC (as site conditions warrant) stand pipes. The piezometers that are installed using drilling methods will be sand packed around the tip, sealed, and completed following the same general procedures presented for monitoring well installation.

### **IV. Survey**

The top of the well riser piezometer stand pipe will be marked for use in maintaining consistent groundwater elevation measurements. The elevation of the marked point on the well riser, the ground elevation, and the well location will then be surveyed to an existing benchmark using standard instruments and survey techniques.

### **V. Well Development**

All monitoring wells will be developed prior to sample collection to remove fine-grained materials that have settled in the well or within the well screen filter pack during installation according to procedures described in Appendix E.

### **VI. Equipment Cleaning**

All well materials, drilling equipment, and associated tools, including augers, drill rods, wrenches, and any other equipment or tools that may have come in contact with soil, and/or groundwater will be cleaned in accordance with the procedures described in Appendix B.

### **VII. Disposal Methods**

If required, all water generated during cleaning and/or well evacuation procedures will be collected and contained on site for determination of appropriate treatment or disposal. In addition, personal protective equipment (e.g., gloves, disposable clothing) and other disposable equipment resulting from cleaning procedures, soil sampling and handling activities will be placed in plastic bags and appropriately contained for proper disposal.

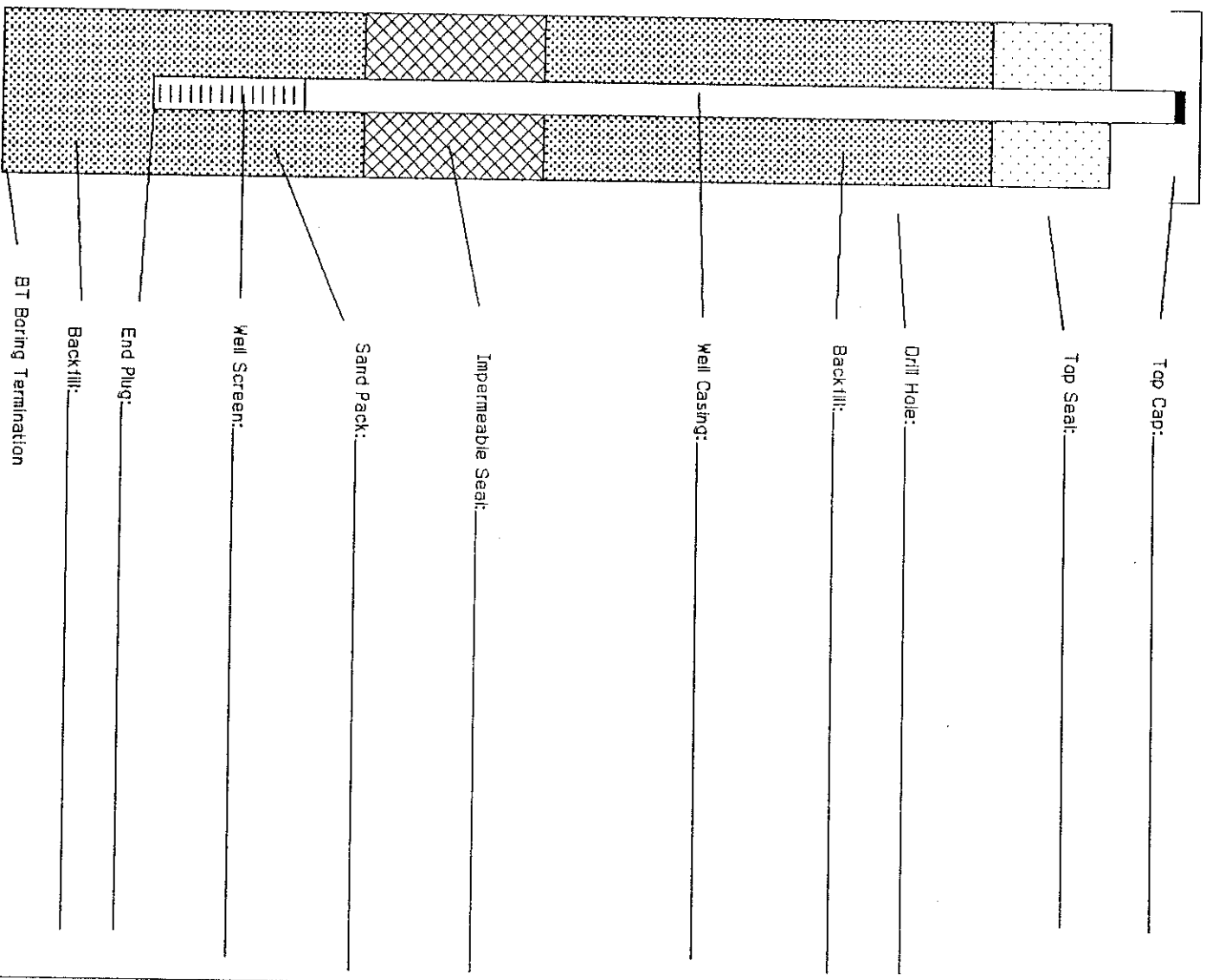
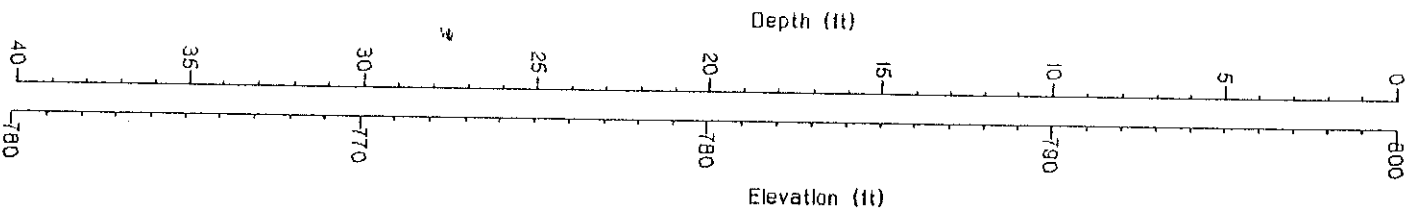


**ATTACHMENT D-1 (TO APPENDIX D)  
MONITORING WELL CONSTRUCTION DIAGRAM**

# WELL CONSTRUCTION (Sample Sheet)

Well/Boring Name: \_\_\_\_\_  
 Project: \_\_\_\_\_

Date Drilled: \_\_\_\_\_  
 Surface Elevation: \_\_\_\_\_



**APPENDIX E**  
**MONITORING WELL/PIEZOMETER DEVELOPMENT PROCEDURES**

## **I. Introduction**

All monitoring wells will be developed to remove fine grained materials that have settled during installation in the well, filter pack, or in the formation materials just outside the filter pack. This process will also help to ensure a good hydraulic connection with the aquifer for the collection of representative groundwater samples. The well will be developed by using surging and water evacuation techniques until the water yield is relatively free of fines. Prior to developing and immediately after the well is opened, the well headspace will be screened for volatile organic vapors using a PID to determine the need for personal protective clothing and equipment, as described in the HASP.

Surging techniques are usually performed by running a surge block up and down the screened interval to force water out of the well in an effort to loosen and suspend trapped sediments in the water column. A weighted bailer or submersible pump may be substituted for a surge block.

Well development water evacuation techniques may include the use of pumps, bailers, or air lift methods. When using a hand or submersible pump for well evacuation, the pump intake should be moved up and down the length of the screen until the well yields clear water. The use of a centrifugal or a suction pump is generally limited to wells with a depth to water not exceeding 25 feet. Where the centrifugal or suction pump is used by connecting the tubing to the top of the riser with air-tight fittings, a surge effect can be created by pumping the well and then releasing the air-tight seal at the riser connection to allow the column of water to drop back down the well. Where the nature of the formation and yield does not allow the use of pumps, bailers may be used for well development.

Well development will proceed until the water is clear and free of fines or sediments. If a more quantitative measure of water clarity and formation representativeness is required, pH, temperature, conductivity, and turbidity may be measured and recorded at regular intervals during well development. Development will then be considered sufficient when these measured parameters have stabilized over a period of at least ten minutes. Procedures for measuring these parameters are presented in Appendix I.

All development water will be collected, containerized, and stored on-site until arrangements are made for proper disposal.

## **II. Materials**

Materials required for monitoring well development using a pump include:

- Personal protective equipment (as required by the Health and Safety Plan);
- Cleaning equipment (as required in Appendix B);
- Photoionization detector (PID) to measure headspace vapors;

- Polypropylene tubing dedicated to each well location, if necessary;
- Plastic sheeting;
- Power source (generator);
- Field notebook;
- Keys to wells;
- Graduated pails;
- Pump;
- Surge block, if necessary;
- weighted pre-cleaned stainless steel bailer;
- 55-gallon DOT-approved drums; and
- Temperature, pH, specific conductance and turbidity meters.

### **III. Procedures**

A detailed procedure for ground-water well development follows:

1. Don appropriate personal protective equipment (as required by the Health and Safety Plan).
2. Cut a slit in a corner of a new piece of plastic sheeting and place the sheeting around the well for use as a clean work area.
3. Clean all equipment entering each monitoring well as specified in Appendix B and then place on the plastic sheeting.
4. Unlock and open the well cover while standing upwind of the well. Remove the well cap. Measure headspace vapors as described in Appendix H.

5. Lower pump and/or tubing into the well. If a centrifugal/suction pump is used, attach the hose from the pump to the well riser. Surging may be accomplished when using a centrifugal/suction pump by periodically releasing the hose from the well riser to allow water in the riser to drop back down into the well.
6. Surge several times by raising and lowering the pump in the well to suspend fine-grained material into the water column. A surge block or weighted bailer may also be used to surge the well prior to inserting the pump.
7. Turn on pump. If well runs dry, shut off pump and allow the well to recover before pumping again.
8. Collect a sample of groundwater in a container and record the temperature, pH, specific conductance, and turbidity.
9. Contain all water in 55-gallon DOT-approved drums, if necessary.
10. Repeat steps 6 through 8 until ground water appears relatively sediment-free and/or the temperature, pH, specific conductance, and turbidity readings have stabilized. Ideally, turbidity readings will decrease to less than 5 NTU.
11. Raise the development pump 2 feet and repeat Steps 7 through 10.
12. Repeat step 11 until the entire well screen has been developed and criteria for development completion are over.
13. Remove the developing pump from the well.
14. Secure the well cover and lock the well if sampling procedures are not to be implemented.
15. Place plastic sheeting in plastic bags for appropriate disposal and clean the pump as specified in Appendix B. If dedicated tubing is used, it will be cleaned as specified in Appendix B and stored in plastic bags.

#### **IV. Disposal Methods**

If required, all water generated during cleaning and development procedures will be collected and contained on site for determination of approximate treatment or disposal. In addition, personal protective equipment (e.g., gloves, disposable clothing) and other disposable equipment resulting from cleaning procedures and soil sampling and handling activities will be placed plastic bags and approximately contained for proper disposal.

Pg. of

## LIMNO-TECH INC. WELL DEVELOPMENT FIELD LOG

LIMNO-TECH INC. WELL DEVELOPMENT FIELD LOG				WELL/BORING I.D.
PROJECT NAME	PROJECT CODE	INITIAL	DATE	SCREEN DEPTH

WELL DEVELOPMENT/PURGING - METHOD/EQUIPMENT USED	

[illegible]

COMMENTS:



## **APPENDIX F**

### **GROUNDWATER PURGING AND SAMPLING PROCEDURES**

## **I. Introduction**

Groundwater samples will be collected so as to be representative of the conditions present in the subsurface at the site. To this end, each monitoring well will be properly purged prior to sample collection. In addition, accurate groundwater level measurements will usually be obtained according to the procedures described in Appendix G prior to purging a well. A low-flow sampling pump (e.g., bladder pump) will be preferentially used over a bailer for groundwater sample collection.

## **II. Materials**

The following materials shall be available, as required, during groundwater sampling:

- Personal protective equipment (as required by the Health and Safety Plan);
- Cleaning equipment (as required in Appendix C);
- Photoionization detector (PID) to measure headspace vapors;
- Plastic sheeting;
- Bailer (stainless steel or Teflon, disposable polyethylene bailers may also be used);
- Nylon or polypropylene rope;
- Sampling Pump;
- Water level probe;
- Weighted steel measuring tape;
- Watch or stopwatch;
- Pre-measured bucket (if required);
- Temperature, pH, conductivity meters;
- Insulated coolers, ice, and appropriate packing material;
- Ziploc<sup>®</sup>-type bags;
- Large heavy-duty garbage bags;
- 55-gallon DOT-approved drums (if required);
- Field notebook;
- Appropriate sample containers and forms;
- Relevant well sampling data (e.g., previous water levels, well depth);
- Keys to wells; and
- Filtration apparatus.

### **III. Procedures**

1. Record pertinent data on the field log (Attachment F-1, Groundwater Sampling Field Log, or equivalent).
2. Label all sample containers with the date, time, well number, site location, sampling personnel, and other requested information.
3. Don appropriate personal protective equipment (as required by the Health and Safety Plan).
4. Put on a new pair of disposable gloves. The gloves are well-specific and a new pair will be donned and worn for sample collection at each well.
5. Cut a slit in a corner of a new piece of plastic sheeting and place the sheeting around the well for use as a clean work area.
6. Clean all sampling equipment according to the procedures in Appendix B and place on the plastic sheeting. Do not let any soil or other material fall on the plastic sheeting, unless it comes from the well.
7. Unlock and open the well cover while standing upwind of the well. Remove the well cap and place it on the plastic sheeting. Measure headspace vapors as describe in Appendix H.
8. Obtain water level and well depth measurements following the procedures in Appendix G and record them on the sampling log sheet or in the field notebook. Clean the water level probe and weighted steel measuring tape after each use according the procedures of Appendix B.
9. Calculate the number of gallons of water in the well (i.e., one well volume) using the following formula:

$$V_w = 0.04 d^2 L; \text{ where}$$

$V_w$  = volume of water, in gallons;

$d$  = well casing inside diameter, in inches;

$L$  = length of the water column in the well, in feet

( $L$  is calculated by subtracting the depth to the water table from the depth to the bottom of the well, as measured in feet from the top of the well riser)

Record the well volume on the Groundwater Sampling Field Log (Attachment F-1).

10. Field calibrate the temperature, pH, and conductivity meters on a daily basis, according to the manufacturer's instruction manual, and record the calibration information on the appropriate field calibration log (Appendix I).
11. Remove a minimum of three well volumes of groundwater from the well using a low-flow sampling pump (preferred) or bailer. If the well goes dry and does not recover within a short period of time to continue purging, allow the well to recharge before sampling.
12. The water will be contained in 55-gallon DOT-approved drums, if necessary. Properly label the drum (e.g., purge water, MW-\_\_\_\_, date, time).
13. Note the pumping rate and duration on the field log.
14. Measure and record the initial temperature, specific conductance, and pH of the purge water and as purging progresses continue to periodically make additional measurements according to procedures in Appendix I. Purging will be considered complete once the temperature, specific conductance, and pH have stabilized and at least three well volumes have been removed.
15. After the appropriate volume of ground water has been purged from the well or if the well has been pumped dry and allowed to recover, collect the groundwater samples needed for analysis by directly filling the properly labeled sample containers and tightly securing the caps. A low-flow sampling pump is preferred for sample collection to a bailer whenever possible.
16. For samples requiring field filtering, collect the sample directly into the sample container after passing through the in-line disposable filter apparatus.
17. If field preservation is required, place appropriate preservative into the sample container prior to sample collection. Note the preservative and preservative column on the sample container and sampling log.
18. Record groundwater sample collection information on the field log and store the samples in an iced cooler as described in Appendix A.
19. Replace well cap and lock well.
20. Clean the sampling pump system, bailer, and/or filter apparatus following the procedures in Appendix B.
21. Handle, pack, and ship samples according to the procedures in Appendix A.

#### **IV. Disposal Methods**

If required, all water generated during cleaning and well purging procedures will be collected and contained on site for determination of proper treatment or disposal.

In addition, personal protective equipment (e.g., gloves, disposable clothing) and other disposable equipment resulting from cleaning and sampling procedures will be placed in plastic bags and appropriately contained for proper disposal.

**ATTACHMENT F-1 (TO APPENDIX F)  
GROUNDWATER SAMPLING FIELD LOG**

## GROUND-WATER SAMPLING FIELD LOG

Project Name		Code	By	Date	Time
Location:		Parameters:			
Well Number:		Well Location:			
Lock Number:		Casing Material/Diameter:			
Pipe Ht. Above Ground:		Well Depth:			
Static Water Depth (From T.O.C.):					
Purge Equipment:					
Purge Volume Requirement (gal):		Volume Purged:			
Well Development / Pumping Characteristics:					
Decontamination Procedures:					
Sample Containers:					
Sample Preservation:					
Field Filtered (Y or N):					
Physical Appearance of Sample:					
Sample Numbers:					
Samples Delivered To:					
Comments:					
Signature:					

**APPENDIX G**  
**MONITORING WELL/PIEZOMETER**  
**WATER LEVEL MEASUREMENT PROCEDURES**



## **I. Introduction**

Water level measurement data (i.e., groundwater static level elevations) will be used in the development of potentiometric surface maps. The water levels will be obtained using an electric water level probe or chalked steel tape.

## **II. Materials**

The following materials, as required, will be made available during water level measurement activities:

- Personal protective equipment (as required by the Health and Safety Plan);
- Cleaning equipment (as required in Appendix C);
- Photoionization detector (PID) to measure headspace vapors;
- Appropriate forms and field notebook;
- Keys for wells;
- Water level probe;
- Hacksaw or waterproof marker;
- Weighted steel measuring tape; and
- Watch (to record time of day).

## **III. Procedures**

1. Don personal protective equipment (as required by the Health and Safety Plan).
2. Clean the water level probe and cable in accordance with the cleaning procedures in Appendix B.
3. Unlock and open the well cover while standing upwind of the well. Remove the well cap. Measure headspace vapors as described in Appendix H. If the well cap is not vented, allow the water level to equilibrate in the well for 1-2 hours prior to measurement.
4. Locate the measuring reference point on the well riser or casing. If one is not found, create a reference point by notching the casing with a hacksaw or by using a waterproof marker. If a well has both inner and outer casings, use the top of the inner casing as the reference point. All down-hole measurements will be taken from the reference point.
5. Lower the water level probe until the indicator signals it is at the water surface. Measure and record the depth to water from the reference point, to the nearest hundredth of a foot.

6. Lower the water level probe or weighted steel measuring tape to the bottom of well. Measure and record the depth to the bottom of the well from the reference point, to the nearest hundredth of a foot. If weights are suspended from the water level probe or measuring tape, be sure to add the length of the weight to the measured reading.
7. Remove weighted steel measuring tape or water level probe from the well.
8. Clean the water level probe, cable, and/or measuring tape in accordance with the cleaning procedures in Appendix B.
9. Replace well cap and lock well.

#### **IV. Disposal Methods**

All water generated during cleaning procedures will be collected and contained on-site for determination of proper treatment or disposal.

Personal protective equipment (e.g., gloves, disposable clothing) and other disposable equipment resulting from cleaning and sampling procedures will be placed in plastic bags and appropriately contained for proper disposal.

**ATTACHMENT G-1 (TO APPENDIX G)  
WATER LEVEL RECORD**

## WATER LEVEL RECORD

Project Name:Project Code:

**Initials:**

Date:[illegible]

**APPENDIX H**  
**WORK AREA AIR MONITORING PROCEDURES**

## **I. Introduction**

A work area air monitoring program will be conducted during site investigations. The objective of the program will be to assess exposure to on-site workers from volatile organic vapors in the air and to determine the level of personal protective equipment in accordance with the HASP.

A photoionization detector (PID) will be used to monitor volatile organic compounds (VOCs) in the breathing zone. Monitoring well headspaces will be screened with a PID as a precautionary measure each time the well cover is opened. A description of the PID, including calibration and maintenance procedures and log, is presented in attachment H-1.

## **II. Materials**

The following materials, as required, shall be available while monitoring work area air:

- Personal protective equipment (as required by the Health and Safety Plan);
- PID and operating manual; and
- Calibration canisters for PID.

## **III. Procedures**

The procedures for well headspace screening are presented below and in the appropriate sampling procedure appendices.

1. Don personal protective equipment (as required by the Health and Safety Plan).
2. Calibrate the PID according to the manufacturer's operation manual or Attachment H-1.
3. If so equipped, set the alarm at desired level.
4. Measure and record the background PID reading.
5. Unlock and open the well cover while standing upwind of the well.
6. Remove the well cap.

7. Place the PID probe approximately 6 inches above the top of the casing.
8. If the PID reading is less than 1 PID unit above background, proceed,
9. If the PID reading is more than 1 PID unit above background, upwind from the well for 10 minutes to allow the well headspace volatiles to dissipate.
10. Repeat well headspace measurement. If the reading is 1 PID unit above background and benzene or trichloroethene is suspected to be present in the groundwater, appropriate cartridges and filters as required in the Health and Safety Plan and proceed.

#### **IV. Equipment Cleaning**

After each use, the readout unit should be wiped clean with a clean cloth or paper towel. The UV lamp window cleaning procedures and other maintenance procedures are described in the manufacturer's operation manual for the instrument or Attachment H-1.

**ATTACHMENT H-1 (TO APPENDIX H)  
CHARACTERISTICS OF THE PHOTOIONIZATION DETECTOR (PID)**



## **I. Introduction**

Photoionization detectors (PIDs) can be used at a site to protect worker health and safety. PIDs are often used to monitor organic vapors in the workspace area or the headspace of groundwater monitoring wells, and to monitor organic vapors associated environmental samples. The information obtained from PID measurements can alert workers to conditions that require the selection of appropriate work procedures, sample handling protocols, and personal protective equipment.

The PID instruments that will likely be used on this site are the Photovac Micro TIP (using a 10.6 eV lamp) and the HNu PI-101, (using a 10.2 eV lamp). General operating principles and limitations for PIDs and specific calibration and maintenance procedures for the above two instruments are presented in the following sections.

## **II. Operating Principles**

A photoionization detector (PID) is an instrument commonly used to detect and measure the presence of organic vapors. The PID uses a lamp that emits ultraviolet (UV) to ionize organic vapor molecules. During ionization of volatile organic constituents, free electrons are generated that produce a current proportional to the number of ions present, and the resulting signal is translated as a total organic vapor concentration on a parts per million (ppm) basis. The PID ionizes constituents with ionization potentials that are lower than the energy of the lamp used. The PID does not ionize compounds found in ambient air (O<sub>2</sub>, N<sub>2</sub>, CO, CO<sub>2</sub>). Interchangeable lamps that emit different energy levels of UV light can be used to analyze constituents with different ionization potentials and thus allow some degree of selectivity. Some performance factors for PID instruments are listed below:

- Medium skill level required for analysis.
- Calibration frequency is 1-3 times per day.
- Very easy to maintain.
- Photoionization lamp requires periodic cleaning/changing.
- Moist atmospheric conditions (e.g., rain) and high relative humidity (> 90%) in the sample can "quench" the signal resulting in low readings.
- Dust particles may absorb ultraviolet energy and cause erratic responses in PIDs that do not have filters.

- Responses may be affected by power lines, transformers, or radio wave transmitters.
- For concentrations > 150 ppm total organic vapors (TOV), the PID may provide non-linear or erratic responses.
- Does not detect methane or other alkanes, thus eliminating anomalous methane contributions.

Operating specifications of the particular PID used at a site should be consulted in the manufacturer's operating manual. Useful specifications to become familiar with for increase efficiency of operation include:

- Battery recharge time;
- Operating time on a full charge;
- Response time of the instrument;
- Sample flow rate;
- Air filter pore size;
- Whether the instrument is designed to minimize moisture effects.

### **III. Limitations**

A PID provides relative concentrations of total organic vapors in the air. Many volatile and non-volatile substances can not be detected with PIDs. The meter values should not be considered representative of actual specific compound concentrations in the sample. The readings obtained with the PID may not be considered entirely accurate for mixtures of constituents and high concentration levels. The PID readings are relative to the calibration gas used (usually isobutylene).

#### **IV. Photovac MicroTIP<sup>R</sup>**

##### **A. Calibration**

MicroTIP<sup>R</sup> must be calibrated in order to display concentration in units equivalent to ppm. The instrument should be calibrated at least once daily. First a supply of zero air, which contains no ionizable gases or vapors, is used to set MicroTIP's zero point. Then, span gas, containing a known concentration of a photoionizable gas or vapor, is used to set the sensitivity. Usually clean ambient air will be suitable as zero air. If there is any doubt, use a commercial source of zero grade air and a second sampling bag. Isobutylene at 100 ppm in air is recommended as span gas.

The MicroTIP<sup>R</sup> should be calibrated using the following procedures:

1. Connect the supplied regulator to the span gas cylinder. Hand tighten the fittings. Observe proper handling techniques for all gases.
2. Open the valve on the gas bag by turning the valve stem fully counterclockwise.
3. Attach the nut to the regulator. Hand tighten the fittings.
4. Turn the regulator knob counterclockwise about half a turn to start the flow of gas.
5. Fill the gas bag about half full and then close the regulator fully clockwise to turn off the flow of gas.
6. Disconnect the bag from the adapter and empty it. Flush the bag a few times with the span gas and then fill it.
7. Close the gas bag by turning the valve clockwise.
8. Press SETUP and select the desired Cal Memory with the arrow keys (or use the default) and press ENTER. Press EXIT to leave Setup.

9. Press CAL and enter the desired response factor from the list below. If the compound is not in this list or you are not looking specifically for one compound, then enter 1.00. The concentration detected by MicroTTP<sup>R</sup> will be multiplied by the response factor before it is displayed and logged.

Compound	Response Factor
Acetone	1.2
Benzene	0.6
Butyl Acetate	2.9
Cyclohexane	1.9
Cyclohexanone	0.9
Ethyl Acrylate	3.3
n-Heptane	3.7
Methyl Ethyl Ketone	0.9
Methyl Isobutyl Ketone	1.1
Methyl Methacrylate	1.5
n-Octane	2.6
Perchloroethylene	0.7
Styrene	0.5
Toluene	0.5
Trichloroethylene	0.6

10. Expose MicroTTP<sup>R</sup> to zero air, (usually clean ambient air). Press ENTER and MicroTTP<sup>R</sup> sets its zero point.
11. MicroTTP<sup>R</sup> then asks for the span gas concentration. Enter the known span gas concentration and then connect the span gas bag adapter to the inlet. Usually 100 ppm isobutylene is used.
12. Press ENTER and MicroTTP<sup>R</sup> sets its sensitivity.
13. When MicroTTP's display reverts too normal, MicroTTP<sup>R</sup> is calibrated and ready for use. Remove the span gas bag from the inlet.

## **B. Recharging the Battery**

When the instrument status reads LoBat, the MicroTIPR battery pack requires recharging. A fully charged battery powers MicroTIPR for 7 hours. If the instrument is to be used for more than 7 hours, carry a spare battery pack. Before beginning operation of MicroTIPR, the battery pack must be charged according to the following procedures. (Do not remove, replace or charge the battery pack in a hazardous location.):

1. Ensure MicroTIPR is off by pressing the front of the power switch.
2. Set the voltage selector switch on the bottom of the batter charger to the appropriate AC line voltage.
3. Press the release button on the bottom of MicroTIPR and remove the battery pack by sliding it backwards.
4. Plug the charger into the battery pack and then into an AC outlet and allow the battery pack to charge until the red LED on the battery charger flashes slowly. If the battery pack is fully discharged this will take about 8 hours.
5. After charging remove the charger, first from the wall outlet then from the battery pack, and slide the battery pack back onto MicroTIPR. There is no danger of overcharging the battery.
6. The instrument is now fully charged and ready for use.

## **C. Cleaning the Lamp Window**

During the course of normal operation a film builds up on the window of the detector lamp. The rate at which the film develops depends on the type and concentration of the gases and vapors being sampled and results from the UV light interacting with them. As a guide, clean the window every 24 hours of operation.

Do not clean the detector lamp in a hazardous location

1. Ensure the instrument is turned off.
2. Hold the black detector housing in one hand and unscrew it from the body of MicroTIPR. Remove the housing, being careful not to lose the o-ring seal on top of the photoionization detector. The detector cell, lampholder, and high frequency (HF) driver circuit board are now exposed.

3. Unplug the red (C 2 Silver Pin) and yellow (C 8 Gold Pin) wires from the HF driver circuit board.
4. Locate the black (or green) ground wire. Loosen the screw on the HF driver circuit board and disconnect the black wire.
5. Hold the lampholder in one hand so it will not rotate and carefully unscrew the detector cell with the red, yellow and black wires attached. Note: **DO NOT** touch the fine wire mesh inside the detector cell. Any dust or dirt in the detector cell can be blown out with a gentle jet of compressed air.
6. Leaving the lamp spring in place, remove the lamp from the lampholder.
7. To remove the film, gently rub the window of the lamp with a lint free tissue moistened with methanol. Use only **HPLC** grade or spectroscopic grade methanol to clean the lamp window.
8. Allow the window to dry and then, without touching the window, replace it in the lampholder.
9. Replace the detector cell squarely on the lampholder. Finger tighten only. Do not over-tighten.
10. Replace the black wire below the screw on the HF driver circuit board and tighten the screw down. Plug the yellow wire onto the gold pin and the red wire onto the silver pin on the HF driver circuit board.
11. Check the lampholder and ensure it is securely seated by hand. Check that the o-ring seal is in position.
12. Replace the detector housing and tighten by hand.
13. Calibrate MicroTIP<sup>R</sup> and then continue normal operation.

## V. HNU<sup>R</sup> PI-101

### A. Calibration

The HNU<sup>R</sup> meter must be calibrated in order to display concentration units equivalent to ppm. The instrument should be calibrated at least once daily according to the following procedures:

1. Turn the FUNCTION switch to the BATTERY CHECK position. Check that the indicator is within or beyond the green batter arc. If indicator is below the arc or the red LED is lit, the battery must be charged.
2. Turn the FUNCTION switch to the STANDBY position and rotate the ZERO POTENTIOMETER until the meter reads zero. Wait 15 to 20 seconds to confirm the adjustment. If unstable, readjust.
3. Check to see that the SPAN POTENTIOMETER is adjusted for the probe being used. (usually 10.2 eV).
4. Set the FUNCTION switch to the desired ppm range (0-20, 0-200, or 0-2,000). A violet glow from the UV source should be visible at the sample inlet of the probe/sensor unit.
5. Listen for the fan operation to verify fan function.
6. Connect one end of the sampling hose to the calibration canister regulator outlet and the other end to the sampling probe of the PID. Open the regulator valve and take a reading after 5 to 10 seconds. Adjust the span potentiometer to produce the concentration listed on the span gas cylinder.
7. The HNU is now ready for use.

### B. Cleaning the lamp window

The UV light source window and ionization chamber should be cleaned in the following manner once a month:

1. With the PID off, disconnect the sensor/probe from the unit.
2. Remove the exhaust screw, grasp the end cap in one hand and the probe shell in the other, and pull apart.

3. Loosen the screws on the top of the end cap, and separate the end cap and ion chamber from the lamp and lamp housing.
4. Tilt the lamp housing with one hand over the opening so that the lamp slides out into your hand.
5. Clean the lamp with lens paper and HNu<sup>R</sup> cleaning compound (except 11.7 eV). For the 11.7 eV lamp use a chlorinated organic solvent.
6. Clean the ion chamber using methanol on a Q-tip<sup>R</sup> and then dry gently at 50°C to 60°C for 30 minutes.
7. Following cleaning, reassemble by first sliding the lamp back into the lamp housing. Place ion chamber on top of the housing, making sure the contacts are properly aligned.
8. Place the end cap on top of the ion chamber and replace the two screws, tighten the screws only enough to seal the o-ring.
9. Line up the pins on the base of the lamp housing with pins inside the prove shell and slide the housing assembly into the shell.



**ATTACHMENT H-2 (TO APPENDIX H)  
PHOTOIONIZATION DETECTOR CALIBRATION AND MAINTENANCE LOG**

# PHOTOIONIZATION DETECTOR CALIBRATION AND MAINTENANCE LOG

100

**Figure 1**

100

HNa 9.5eV

9.5eV

11.7eV

9.5eV

10.6eV

[illegible]

**APPENDIX I**  
**FIELD WATER QUALITY MEASUREMENT PROCEDURES**

## **I. Introduction**

Water quality parameters, such as turbidity, specific conductance, pH, and temperature, are usually measured in the field during groundwater monitoring well development and purging activities. The pH and conductivity will be recorded using portable meters with temperature-compensating pH and conductivity electrodes. Turbidity will be measured in Nephelometric Turbidity Units (NTU) with a turbidity meter. The temperature will be measured with a glass, digital, bimetal thermometer, or combination temperature/pH or temperature/conductivity meter. During well development and purging, the above hydrochemical parameters should be recorded until the readings have stabilized to indicate a completed process. Attachment I-1 contains the calibration and maintenance log for the above referenced meters.

## **II. Materials**

The following materials, as required, shall be available during field measurement of water quality:

- Personal protective equipment (as specified in the Health and Safety Plan);
- Clean container;
- Temperature, pH, conductivity, and turbidity meters;
- Manufacturer's operating manuals for each instrument;
- Sodium chloride standard solution, 1,000 mg/L;
- pH buffers 7.00 and 4.00;
- Turbidity standards;
- Nephelometric sample tubes;
- Cleaning equipment (as required in Appendix B);
- Fine screwdriver (for meter calibration adjustments);
- Extra batteries for the meters;
- Distilled/deionized water; and
- Appropriate forms and field notebook.

### III. Procedures for Measuring pH

#### A. Operation Procedure (pH meters)

1. Calibrate pH meter.
2. Rinse probe in distilled/deionized water.
3. Fill a suitably sized container with water from the sample.
4. Measure and recorded temperature of sample. If the meter is not designed for temperature compensation adjust the temperature.
5. Insert probe into the container and obtain a reading. The meter will read 0 and 14, in 0.1 increments.
6. Rinse probe off in distilled/deionized water.
7. Log results in field notebook.

#### B. Instrument Specific Calibration Procedures (pH)

##### *Cole Parmer pHep and pHep Plus Meter Calibration*

##### *Preparing the Buffer Solutions*

1. To prepare the buffer solutions, remove on buffer tablet from the foil pouch and place it into one of the plastic butter jars.
2. Fill the buffer jar with 20 ml distilled or deionized water. The first ridge molded into the jar corresponds to a 20 ml volume.
3. Cap the vessel and swirl gently until tablet dissolves.

##### *Calibrating the pHep and pHep Plus*

1. Before first use, remove the black cap and soak the electrode for at least 1/2 hours in buffer or tap water to condition it. Immerse the tester up to but not beyond the first ridge above the electrode. *Never immerse the tester above this level.*

2. Calibrate in the buffer solution value closest to the expected pH value of the test solution. For the best accuracy, the buffer must be at the same temperature as the test solution.
3. Dip the tester into the buffer and allow the reading to stabilize.
4. Use the small screwdriver to adjust the screw located in the hole on the back of the unit until the display reads the buffer value.
5. Rinse the sensor area with distilled or deionized water. Use tap water if these are not available. Check reading again in the buffer.
6. If the reading is the same as the buffer value, rinse as described in step 5 and proceed with the pH testing.
7. If the reading differs from the buffer value, repeat steps 3 through 5. To confirm that you are getting a proper response, check the unit in a different pH buffer value.
8. For maximum life and fast responses, rinse the pH tester thoroughly after each use and keep the electrode wet by inserting a small piece of clean wet tissue or sponge into the black cap before storing.

#### *Orion Model 259 A pH Meter Calibration*

A one or two buffer calibration should be performed before pH is measured. It is recommended that a two buffer calibration using buffers that bracket the expected sample range be performed at the beginning of each day to determine the slope of the electrode. This serves the dual purpose of determining if the electrode is working properly and storing the slope value in the memory. Perform a one buffer calibration every two hours to compensate for electrode drift.

Prior to calibration, scroll through the SETPH menu and ensure all parameters are set properly for the analysis you want to perform. Select the resolution desired and verify the isopotential point is set correctly for the electrode.

Autocalibration is a feature of the Model 250A Meter that automatically recognizes the buffer's 7.00, 4.01, and 10.01 with a range of  $\pm 0.5$  pH units. During calibration the user waits for a stable, the meter automatically recognizes and displays the temperature-corrected value for that buffer. Pressing yes enters the value in memory.

*Note: Do not scroll when using autocalibration*

The 250A Meter compares actual values to theoretical values to determine if the buffer is within range. Results greater than  $\pm 0.5$  pH units from the correct value will trigger an operator assistance code. For best results, it is recommended that an Automatic temperature compensation (ATC) probe be used. If an ATC probe is not used, all samples and buffers should be at the same temperature or use manual temperature compensation should be used.

#### *Autocalibration with Two Buffers*

1. Connect electrode(s) to meter. Choose either 4.01 and 7.00, or 7.00 and 10.01 buffers, whichever will bracket your expected sample range.
2. Press the **mode** key until the pH mode indicator is displayed.
3. Rinse electrodes with distilled/deionized water, shake off excess water, and place into either 4.01, 7.00, or 10.01 buffer.
4. Press **2nd cal**. CALIBRATION is displayed above the main field and the time and date of the last calibration are displayed. After a few seconds P1 is displayed in the lower field. P1 indicates that the meter is ready for the first buffer and a value has not yet been entered. When the electrode is stable, READY will be displayed and the temperature-corrected value for the buffer is displayed. Press **yes**. The display will remain frozen for two seconds, the P2 will be displayed in the lower field indicating the meter is ready for the second buffer.
5. Rinse electrodes as in Step 3 and place in second buffer. Wait for stable pH display and press **yes**. After the second buffer value has been entered the electrode slope will be displayed. SLP appears in the lower field with the actual electrode slope in percent in the main field. The meter automatically advances to the measure mode. MEASURE is displayed above the main field.
6. Rinse electrodes as in step 3 and place into sample. Record pH directly from the main meter display and temperature from the lower field.

#### *Autocalibration with One Buffer*

1. Connect electrode(s) to meter. Select one buffer, either 4.01, 7.00, or 10.01, whichever most closely approximates the expected sample pH.

2. Press the **mode** key until the pH mode indicator is displayed.
3. Rinse electrodes with distilled/deionized water, shake off excess water, place electrodes into the buffer, and press **2nd cal**. CALIBRATE will be displayed above the main field and the time and date of the last calibration will be displayed. After a few seconds P1 will be displayed in the lower field.
4. Wait for a stable reading (the display will flash) and press **yes**. The display remains frozen for two seconds the P2 is displayed in the lower field.
5. Press **measure**. SLP will be displayed in the lower field and the electrode slope in memory in the main field. If necessary enter the correct electrode slope determined by a two point calibration and press **yes**. If slope value is unknown enter 100.0 or perform a two buffer calibration.
6. Rinse electrodes as in step 3 and place into sample. Read the pH directly from the main display and temperature from the lower field.

#### C. Maintenance Procedures (pH meters)

1. Replace batteries on a regular basis.
2. Store electrode in protective casing when not in use.
3. Keep records of usage, maintenance, calibration, problems, and repairs.
4. After use, the meter will be inspected and any problems recorded in the field notebook.
5. A replacement meter will be available onsite or ready for overnight shipment.
6. pH meter will be sent back to manufacturer for service when needed.

#### IV. Procedures for Measuring Conductivity

Conductivity is the ability of a solution to pass an electric current. This current is carried by inorganic dissolved solids. The measurement of conductivity is useful to relate the chemical purity of the water and the amount of dissolved solids in a solution.



A. Operation Procedure (Conductivity meter)

1. Calibrate the conductivity meter.
2. Rinse probe in distilled/deionized water.
3. Fill a suitably sized container with water from the sample.
4. Turn meter on. (If applicable, use temperature compensated scale; start with 2mS/cm and switch to 20mS/cm scale if overrange signal is displayed).
5. Insert probe (as specified in calibration procedures) into sample container. Allow sufficient time for probe to reach equilibrium with water (usually 10-20 seconds) and obtain a reading. The meter will read between 0 and 20mS/cm depending on the meter used and scale selected.
6. Record results in the field notebook.
7. Rinse probe off in distilled/deionized water.
8. If the electrodes become coated with foreign compounds, the probe should be cleaned with a detergent solution or isopropyl alcohol and then rinsed with distilled/deionized water.

B. Instrument Specific Calibration Procedures (Conductivity)

*Corning PS-17 Conductivity Meter Calibration*

1. Remove protective cap from the bottom of the meter.
2. Turn on meter using ON/OFF switch.
3. Immerse meter to approximately 1-1/2 inches into the know calibration solution (usually 1000 mg/l sodium chloride). **CAUTION: DO NOT IMMERSE ABOVE DISPLAY LEVEL.**
4. Adjust the reading using the trimmer located next to the pocket clip on the back of the unit.
5. Stir gently and wait a few seconds for reading to stabilize.
6. When not in use, turn switch **OFF** and replace the protective cap.

7. To improve meter performance, clean the stainless steel electrode periodically by rinsing in alcohol for a few minutes.
8. If the display becomes faint or disappears, replace all batteries. To change the batteries, carefully pull out the battery case and replace batteries. (Duracell MP675H or equivalent)

#### *YSI Model 3000 T-L-C Meter Calibration*

The T-L-C System is calibrated at the factory. There are no user adjustments inside the instrument. Should you suspect that your instrument is out of calibration, send it to the factory for testing and calibration. A calibration check can be made by comparing the instrument reading to a known calibration solution (usually 1000 mg/L sodium chloride) as follows:

#### *Temperature Compensated Conductivity Calibration Check*

1. To measure temperature compensated conductivity, set the function switch to **2 mS/cmTC to 25°C**.
2. Completely submerge the probe and allow sufficient time for it to reach equilibrium with the water. This usually takes 10 to 20 seconds.
3. Observe the displayed value after the reading is stable.
4. If the overrange signal is displayed (1.\_\_\_\_), then the temperature compensated conductivity of the water is in excess of 1.999 (mS/cm). Reset the switch to **20 2 mS/cm (mS/cm) TC to 25°C**. If the overrange signal is still displayed, the conductivity is greater than 19.99 mS/cm (mS/cm) and cannot be measured without first diluting the sample.

#### **C. Maintenance Procedures (Conductivity meters)**

1. Replace batteries on a regular basis.
2. Store electrode in protective casing when not in use. For long term storage, it is best to store conductivity probes in deionized water. Probes stored in water require less frequent platinizing. When probes are stored dry, it is necessary to soak them in deionized water for 24 hours before use.

3. Keep records of usage, maintenance, calibration, and of any problems and repair.
4. A replacement meter will be available on-site or ready for overnight shipment.
5. Conductivity meter will be sent back to manufacturer for service when needed.

#### **V. Procedures for Measuring Temperature**

Temperature readings will be taken at each water sampling location to assist in pH and conductivity measurement. They will also assist in chemical and biological interpretations. A thermometer may be part of a pH/conductivity meter or separate.

##### **A. Operation Procedure (Thermometer)**

1. Rinse thermometer in distilled/deionized water.
2. Immerse thermometer in the water sample and read it to the nearest degree Celsius ( $^{\circ}\text{C}$ ).
3. Record reading in the field notebook.

##### **B. Preventative Maintenance (Thermometer)**

1. Store in protective casing when not in use.

#### **VI. Procedures for Measuring Turbidity**

The measurement of turbidity is useful in that it expresses the amount of suspended particles in the water sample. The accuracy and repeatability of your measurements will be a function of the condition of your standards, your technique, and the quality of the glassware. The following procedures are for use with the LaMotte Model 200s turbidimeter.

##### **A. Standardization and Measurement Procedures**

Two standards are supplied with each 2008, and others are available. The standards are used as a reference to allow you to calibrate, or *Standardize*, the instrument. This typically would be done before a series of measurements, or on some other regular basis, as an assurance of the accuracy of your readings. Since the accuracy of your results will depend on these standards the following observations and precautions are important:

- In an unopened bottle (as supplied) the standards will remain stable indefinitely as long as they are not exposed to excessively hot or cold environments. (Keep between 10°C and 40°C.)
- Once the seal is broken on the standard, the stability is only guaranteed for nine months thereafter, again based on normal environmental conditions.
- To ensure the accuracy of the standard, never transfer anything into the bottle (e.g., don't dilute, don't return standards that have been removed, don't combine with other standards, etc.)
- Do not open the standards in dusty environments, and guard against contaminants entering the bottle while it is open.
- When transferring the standard to a sample tube, be certain that the tube is absolutely clean. A reasonable precaution is to rinse out the inside of the tube with the standard before filling the tube. This wastes a few mL of standard, promptly cap both the sample tube and the standards
- After transferring the standard, promptly cap both the sample tube and the standards bottle.

### *TECHNIQUE*

The handling of the sample tubes and the preparation of the sample is of utmost importance. The glassware must be clean and defect-free. Scratches and/or abrasions will permanently affect the accuracy of your readings.

The Procedures for Turbidimeter Standardization and Sample Measurement are as follows:

1. Use a clean container to obtain a sample of the liquid to be measured. The volume is not critical; somewhere between 50 to 500 mL is fine. Set the container aside and allow the sample time to equilibrate to ambient temperature, and also to allow any entrained gasses to escape. Keep dust or other airborne contaminants from contact with the sample.
2. When the sample has equilibrated, pour a bit of it into the sample tube as a final rinse, and again shake the excess liquid out. Now fill the sample tube to its neck, taking care to pour the sample gently down the side to avoid creating any bubbles.

3. Cap the tube and, while holding the tube by the cap only, wipe the outside surface with a clean, lint-free, absorbent wipe until the tube is dry and smudge-free. handling the tube only by its cap will avoid problems from fingerprints. Set the tube aside on a clean surface that won't contaminate or scratch the bottom of the tube.
4. Select the appropriate range on the 2008, and insert a sample tube containing the standard with a value close to what you suspect the sample you are to be measuring to be.
5. Be certain the chamber is capped, and that the tube is seated at the bottom of the chamber. The green front panel LED must be illuminated, indicating that the lamp is on. Adjust the *Standardization* control so that the display reads the known value of the chosen standard.
6. Withdraw the standard and insert the tube with the sample to be measured. Again, make sure the chamber is capped and the tube is seated on the bottom. The reading should stabilize within 15 seconds. Record the reading and withdraw the tube.
7. If you wish to take repeated measurements or measure several samples in succession, it will not be necessary to readjust the *Standardization* before each reading. Once set it will remain stable for long periods. Of course, you may reinsert the standard at any time to verify the stability of the readings.

#### *GLASSWARE*

The variability in the geometry and quality of the glassware is the predominant cause of variability in the readings that will be obtained. With a few precautions to minimize the effects of these variations, readings that are significantly more accurate than the specified  $\pm 2\%$  may be obtained.

No piece of glassware is ever perfectly cylindrical (or exactly like any other). You will notice that if the tube is rotated in the chamber slightly (say 15° increments) the reading will also vary somewhat. If the tube was always placed into the chamber with the same orientation this source of variability could be eliminated. This can be accomplished if the cap is marked in some way, perhaps with a piece of tape, and always used with the same tube. When inserting the tube with its paired cap you can observe the mark on the cap and always insert it with the same orientation. It is especially useful to do this with the tube used for the standards; any variability in the standardization will affect all subsequent readings.

Once the rotational variability is compensated for, the residual uncertainty is a result of how well the tubes match. If absolute accuracy is necessary in your readings it is possible to calibrate the set of tubes supplied with the 2008. The procedure entails filling all the tubes with the same sample, preferably a sample with a turbidity at the upper end of the range you will normally use, and recording the readings for each tube. The value of the readings are irrelevant, but they can be used to derive a correction factor for each tube relative to any other tube. However, if monitoring trends and following small changes is more of a concern, the simple precaution of always using the same tube (in the same orientation) will effectively eliminate the  $\pm 2\%$  uncertainty. This assumes, of course, that the tubes used for the standards are not switched either.

Following these precautions can allow the precision and repeatability of your readings to approach  $\pm .01$  NTU. Do no forget, however, that since the standardization procedure is based on the standard used, no reading can be considered to be more accurate than the absolute accuracy of the prepared standard solution.

#### B. Maintenance Procedures

1. Recharge battery on a regular basis.
2. Keep instrument (especially sample chamber) clean and dry, and store in protective casing when not in use.
3. Keep records of usage, maintenance, calibration, and of any problems and repair.
4. Keep nephelometric sample tubes clean both inside and out. Replace them when they become scratched or etched. Do not handle the tubes in the region where the light beam enters them.
5. Clean sample chamber periodically.
6. Nephelometer will be sent back to the manufacturer for service when needed.

**ATTACHMENT I-1 (TO APPENDIX I)  
FOR TEMPERATURE, pH, CONDUCTIVITY, AND TURBIDITY METERS**

# TEMPERATURE, pH, CONDUCTIVITY AND TURBIDITY METER CALIBRATION AND MAINTENANCE LOG

[illegible]



**APPENDIX J**  
**IN-SITU HYDRAULIC CONDUCTIVITY (SLUG) TEST PROCEDURES**

## **I. Introduction**

The in-situ hydraulic conductivity at a monitoring well can be determined using slug tests. A solid slug or air slug of known volume is inserted in the well, displacing the water in the well casing. Once the water level has receded to the normal static elevation determined prior to inserting the slug, the slug is rapidly removed and the well recharges to fill the void created by the removal of the slug. The rate of recharge is determined by measuring the change in the water elevation in the well over time. For rapidly recharging wells, a pressure transducer connected to a data logger is the preferred method to record the change in water level over time. For slowly recharging wells, manual measurements using a water level probe and a stop watch suffice to produce accurate data. The time series water level data collected are reduced using the Bouwer and Rice analytical procedure for interpreting slug test data; other analytical solutions may be employed if site conditions warrant.

## **II. Equipment**

For slug tests performed with a solid slug, the following equipment and procedures are employed:

- Solid slug and polypropylene rope
- Hermit SE1000B logger and pressure transducer or
- Water level probe and stop watch
- Appropriate field logs
- Appropriate equipment cleaning equipment
- PID meter
- Portable personal computer
- Appropriate personal protective equipment

## **III. Procedures**

1. Record site, date, time and well number in log and/or field data sheet
2. Unlock the well and remove the well cap while standing upwind of the well. Measure the headspace vapors with the PID meter (see other Appendices for procedures)
3. Measure and record the static water level with the water level probe (see other Appendices for procedures) or insert the pressure transducer for the data logger in the well. Operate the data logger in accordance with the manufacturer's instructions.
4. Lower the slug into the well below the water table

5. Allow the water in the well to return to the static water level determined in step 3.
6. Rapidly remove the slug from the well. If using manual measurement methods, start the stop watch at the same time that the slug is removed.
7. If using manual measurement methods, measure the water level in the well at approximately 15-second intervals. Record the measurements to the nearest 0.01 foot and the time of each measurement. The frequency of measurements can be reduced by half after approximately 4 minutes (every 30 seconds). When the difference between successive readings becomes insignificant ( $<0.02$  ft), the measurement frequency can be reduced until the water level reaches the pre-test static level or the test is completed. If the water level stabilizes in less than 4 minutes, manual measurement methods may not be appropriate, and a data logger should be used.
8. Clean all equipment (see appropriate Appendix for cleaning procedures)
9. Download the data from the data logger, or enter the manually obtained data into the field portable computer.

If the air slug method is used instead of the solid slug, the equipment and procedures will be the same as above with the substitution of the air slug device and oil free air compressor for the solid slug. In addition, the device requires the use of a data logger, and precludes using manual measurement methods. The air slug device consists of 1.25 inch ID, Schedule 40 PVC pipe with valves and fittings at the well head that allow air pressure to be applied or released. There is also a compression fitting to allow the pressure transducer to pass through the device. The pressure transducer is set below the lower end of the pipe to measure the static water level in the well. Air is injected into the device from the compressor, creating a slug and displacing the water in the well, replacing Step 4 above. The water level is allowed to stabilize as in Step 5 above. The slug is then removed from the well, as in Step 6 above, by opening the air release valve, allowing the pressurized air to escape from the device. The change in the static water level is then measured over time using a data logger as described above.

**PHASE I RCRA FACILITY INVESTIGATION  
SITE HEALTH AND SAFETY PLAN**

**Safety-Kleen Corp.  
Chicago Recycle Center  
Cook County, Illinois**

Adopted by: \_\_\_\_\_

Date \_\_\_\_\_

Title \_\_\_\_\_

Adopted by: \_\_\_\_\_

Date \_\_\_\_\_

Title: \_\_\_\_\_

*Prepared by:*  
**LTI, Limno-Tech, Incorporated  
Ann Arbor, Michigan**

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Appendix A.....	Task Hazard Descriptions and General Safety Rules
Appendix B.....	Standard Operating Procedures for Personal Protective Clothing and Equipment
Appendix C.....	Confined Space Entry Procedures
Appendix D.....	Spill Containment Program

## **1.0 INTRODUCTION**

This section of the Site Health and Safety Plan (HASP) document defines general applicability and general responsibilities with respect to compliance with Health and Safety programs.

### **1.1 Scope and Applicability of the Site Health and Safety Plan**

The purpose of this Site Health and Safety Plan is to define the requirements and designate protocols to be followed at the Site during investigation and remediation activities. Applicability extends specifically to all LTI employees and affiliates, and generally to any other project related contractors, subcontractors, and visitors. Employees of other consulting firms and contracted companies will work in accordance with their own independent HASPs, provided that the minimum requirements of this plan are fulfilled.

All personnel on site, contractors and subcontractors included, shall be informed of the site emergency response procedures and any potential fire, explosion, health, or safety hazards of the operation. This HASP summarizes those hazards in Table 1 and Appendix A, and defines protective measures planned for the site.

This plan, and/or its equivalent, must be reviewed by all personnel prior to entering the site.

During development of this plan consideration was given to current safety standards as defined by EPA/OSHA/NIOSH, health effects and standards for known contaminants, and procedures designed to account for the potential for exposure to unknown substances. Specifically, the following reference sources have been consulted:

- OSHA 29 CFR 1910.120 and EPA 40 CFR 311
- EPA, OERR ERT Standard Operating Safety Guides
- OSHA/NIOSH/EPA/USCG Occ. Health and Safety Guidelines
- NIOSH Pocket Guide to Chemical Hazards

### **1.2 Visitors**

All visitors entering the Site will be required to read and verify compliance with the provisions of this HASP. In addition, visitors will be expected to comply with relevant OSHA



requirements such as training (Sec. 4.0), medical monitoring (Sec. 6.0), and respiratory protection (if applicable). Visitors, contractors, and other consultants will also be expected to provide their own protective equipment.

In the event that a visitor does not adhere to the provisions of the HASP, he/she will be requested to leave the work area.

## **2.0 ORGANIZATIONAL RESPONSIBILITY/KEY PERSONNEL**

### **Technical Project Director: Paul Freedman, LTI**

The technical project director is responsible for staffing and the overall administration of all aspects of the project.

### **Project Manager: Greg Peterson, LTI**

The project manager is responsible for oversight of all aspects of the project including health and safety, quality assurance and on-site activities.

### **Project Engineer/Site Safety Officer: Scott Bell, LTI**

The project engineer/SSO is responsible for on-site activities including: sampling, quality assurance, implementing the health and safety plan and the air monitoring program. The project engineer/SSO reports to the project manager.

### **QA/QC Officer: Robert Betz, LTI**

The QA/QC officer is responsible for the development, implementation and oversight of the QA/QC program for the site, and reports to the project manager.

### **Health and Safety Manager: Robert Betz, LTI**

The HSO is responsible for providing corporate health and safety support/oversight for on-site health and safety and employee exposure meeting.

### **Regulatory Agency Project Manager: Lawrence W. Eastep, IEPA, Springfield, IL**

The regulatory agency project manager has responsibility for regulatory oversight, review and approval of the project work plans and report.

### **Site/Facility Representative: Scott Davies, Safety-Kleen, Elgin, IL**

### **Alfred Aghaiepour, Safety-Kleen, Chicago, IL**

The site/facility representative has the responsibility for addressing the legal and environmental requirements of the regulatory agency, generally through coordination between the technical project director or project manager and the regulatory agency project manager.

### **3.0 SAFETY AND HEALTH RISK ANALYSIS**

#### **3.1 Site Background**

This HASP defines the hazards and methods to protect personnel from those hazards as identified in previous site work or background information. The evaluation of hazards is based upon the knowledge of site background. For an overview of historical information concerning the Site see:

- RCRA Facility Assessment, Safety-Kleen Coporation Chicago Recycle Center, Chicago, Illinois, Illinois Environmental Protection Agency, Division of Land Pollution Control, March 1990.
- Closure Progress Report, Safety-Kleen Corporation Chicago Recycle Center, Chicago, Illinois, Canonie Environmental Services Corp., November 1991.
- Supplemental Investigation Report, Safety-Kleen Corporation, Chicago Recycle Center, Chicago, Illinois, Canonie Environmental, December 1991.

The current or upcoming site activities will involve:

- Collection of soil samples using a drill rig and hollow stem augers with split-spoon sampler
- Installation of groundwater monitor wells
- Collection of groundwater samples from wells
- Survey of site features/monitor wells locations and elevations.

The following subsections describe the chemical and physical hazards associated with activities at the site. In addition, the protective measures to be implemented during these activities are identified.

#### **3.2 Chemical/Physical Hazards**

Table 1 provides a list of chemicals believed to be present on-site either in the soil, surface water, or groundwater. Table 2 lists the available chemical/physical hazards for the chemicals listed in Table 1 and available NIOSH/OSHA recommended exposure limits and protective/response actions to be taken. These chemicals may pose possible exposure hazards through ingestion, inhalation, and/or skin contact. Some materials may be known or suspected carcinogens.

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Appendix A lists hazards and preventative actions for the work tasks at the site. Possible exposures to chemicals at the site during the work activities will be controlled and minimized through the use of personal protective equipment and proper standard operating procedures.

It is possible that some work tasks could be implemented in confined spaces. Appendix C presents the confined space entry procedures.

#### **4.0 PERSONNEL TRAINING REQUIREMENTS**

Consistent with OSHA's 29 CFR 1910.120 regulation covering Hazardous Waste Operations and Emergency Response, all site personnel are required to be trained in accordance with the standard. At a minimum, all personnel are required to be trained to recognize the hazards on-site, the provisions of this HASP, and the responsible personnel.

##### **4.1 Preassignment and Annual Refresher Training**

Prior to arrival on-site, each employer will be responsible for certifying that his/her employees meet the requirements of preassignment training. Consistent with OSHA 29 CFR 1910.120 paragraph (e)(3), each employee should be able to provide a document certifying dates of 24 hours of training for workers occasionally on-site for a specific task, or 40 hours of training for general site workers. An employee may also grandfather experienced personnel. Personnel must receive 8 hours of annual refresher training.

##### **4.2 Site Supervisors Training**

Consistent with OSHA 29 CFR 1910.120 paragraph (e)(8), individuals designated as site supervisors require an additional 8 hours of training. The following individuals are identified as site supervisors:

Greg Peterson, LTI  
Bob Betz, LTI

#### **5.0 PERSONAL PROTECTIVE EQUIPMENT TO BE USED**

This section describes the general requirements of the EPA designated Levels of Protection (A-D), and the specific levels of protection required for each task at the Site.

---

## **5.1 Levels of Protection**

Personnel wear protective equipment when response activities involve known or suspected atmospheric contamination, when vapors, gases, or particulates may be generated by site activities, or when direct contact with skin-affecting substances may occur. Full facepiece respirators protect lungs, gastrointestinal tract, and eyes against airborne toxicants. Chemical-resistant clothing protects the skin from contact with skin-destructive and absorbable chemicals.

The specific levels of protection and necessary components for each have been divided into four categories according to the degrees of protection afforded:

**Level A:** Should be worn when the highest level of respiratory, skin, and eye protection is needed.

**Level B:** Should be worn when the highest level of respiratory protection is needed, but a lesser level of skin protection. Level B is the primary level of choice when encountering unknown environments.

**Level C:** Should be worn when the criteria for using air-purifying respirators are met, and a lesser level of skin protection is needed.

**Level D:** Should be worn only as a work uniform and not in any area with respiratory or skin hazards. It provides minimal protection against chemical hazards.

Modifications of these levels are permitted, and routinely employed during site work activities to maximize efficiency. For example, Level C respiratory protection and Level D skin protection may be required for a given task. Likewise the type of chemical protective ensemble (i.e., material, format) will depend upon contaminants and degrees of contact.

The Level of Protection selected is based upon the following:

- Type and measured concentration of the chemical substance in the ambient atmosphere and its toxicity.
- Potential for exposure to substances in air, splashes of liquids, or other direct contact with material due to work being done.
- Knowledge of chemicals on-site along with properties such as toxicity, route of exposure, and contaminant matrix.

In situations where the type of chemical, concentration, and possibilities of contact are not known, the appropriate Level of Protection must be selected based on professional experience and judgment until the hazards can be better identified. Standard operating procedures for inspecting personal protective equipment are presented in Appendix B.

## **5.2 Selected Level of Protection**

For all activities conducted at this site Level D protection is appropriate. Level D personal protective equipment (PPE) includes:

- Coveralls: cotton and/or rain gear
- Gloves: cotton, leather, rubber, or vinyl
- Boots/shoes: leather, steel toe
- Safety glasses
- Hardhat

## **5.3 Reassessment of Protection Program**

The Level of Protection provided by PPE selection shall be upgraded or downgraded based upon a change in site conditions or findings of investigations.

When a significant change occurs, the hazards should be reassessed. Some indicators of the need for reassessment are:

- Commencement of a new work phase, such as the start of drum sampling or work that begins on a different portion of the site.
- Change in job tasks during a work phase.
- Change of season/weather.
- When temperature extremes or individual medical considerations limit the effectiveness of PPE.
- Contaminants other than those previously identified are encountered.
- Change in ambient levels of contaminants.
- Change in work scope which effects the degree of contact with contaminants.

## **5.4 Work Mission Duration**

Work mission duration limitations related to wearing PPE are variable and dependent upon:

- Air supply consumption with a Level A or B SCBA unit - air supply will be monitored and work will be halted prior to consumption of the entire supply.

- Permeation and penetration of protective clothing - work duration will be limited to permeation or "breakthrough" times associated with the protective clothing equipment materials used so that new protective clothing/equipment may be donned. Penetration through leakage of fasteners or valves on PPE will be inspected for and if found indicate stoppage of all work until the situation is remedied.

- Ambient temperature extremes - heat or cold stress will be monitored by each worker so that sufficient means (use of appropriate PPE heating/cooling packs, rest breaks, etc.) can be implemented to avoid these conditions.

Segments of work while wearing SCBA will generally have a shorter work duration. However, at all times conditions will be monitored by all site workers so that work task duration can be adjusted to appropriate and safe periods of time. Before the workers actually begin work in their PPE ensembles, the anticipated duration of the work mission should be established.

## **6.0 MEDICAL SURVEILLANCE REQUIREMENTS**

Medical monitoring programs are designed to track the physical condition of employees on a regular basis as well as survey preemployment or baseline conditions prior to potential exposures. All employees will have medical monitoring in compliance with OSHA regulations. The medical monitoring program is a part of each employers Health and Safety program.

## **7.0 FREQUENCY AND TYPES OF PERSONAL AIR MONITORING/SAMPLING**

Personal air monitoring will be performed for any necessary confined space entry activities according to the Confined Space Entry procedures of Appendix C.

## **8.0 NEAREST MEDICAL ASSISTANCE**

Figure 1 provides a map of the route to the nearest medical facility which can provide emergency care for individuals who may experience an injury or exposure on-site. The route to the hospital should be verified by the HSO, and should be familiar to all site personnel.

## **9.0 DECONTAMINATION PLAN**

Decontamination procedures for equipment and materials are specified in the applicable Site Work Plans. Decontamination procedures for personnel contact with chemicals are provided in Table 2.

## **10.0 EMERGENCY RESPONSE/CONTINGENCY PLAN**

This section describes contingencies and emergency planning procedures to be implemented at the Site. This plan is compatible with local, state and federal disaster and emergency management plans as appropriate.

### **10.1 Pre-Emergency Planning**

During the site briefings held periodically/daily, all employees will be trained in and reminded of provisions of the emergency response plan, communication systems, and evacuation routes. Appendix A identifies the hazardous conditions associated with specific site activities. The plan will be reviewed and revised if necessary, on a regular basis by the HSO. This will ensure that the plan is adequate and consistent with prevailing site conditions.

### **10.2 Personnel Roles and Lines of Authority**

The Site Supervisor has primary responsibility for responding to and correcting emergency situations. This includes taking appropriate measure to ensure the safety of site personnel and the public. Possible actions may involve evacuation of personnel from the site area, and evacuation of adjacent residents. He/she is additionally responsible for ensuring that corrective measures have been implemented, appropriate authorities notified, and follow-up reports completed. The HSO may be called upon to act on the behalf of the site supervisor, and will direct responses to any medical emergency. The individual contractor organizations are responsible for assisting the project manager in his/her mission within the parameters of their scope of work.

### **10.3 Emergency Recognition/Prevention**

Table 2 and Appendix A provide a listing of chemical and physical hazards onsite. Additional hazards as a direct result of site activities are listed in Table 3, as are prevention and control techniques/mechanisms. Personnel will be familiar with techniques of hazard recognition from preassignment training and site specific briefings. The HSO is responsible for ensuring that prevention devices or equipment is available to personnel.

### **10.4 Emergency Contact/Notification System**

The following list provides names and telephone numbers for emergency contact personnel. In the event of a medical emergency, personnel will take direction from the HSO and notify the appropriate emergency organization. In the event of a fire or spill, the site supervisor will notify the appropriate local, state, and federal agencies.

---

<u>Organization</u>	<u>Telephone</u>
LTI, Limno-Tech, Inc.	313/973-8300
Chicago Fire Department Ambulance	911
Chicago Police Department	911
Chicago Fire Department	911
Berz Ambulance	312/733-2400
Hospitals: (Emergency Room)	
University of Illinois Medical Center	312/996-7297
Poison Control Center	800/942-5969
National Response Center	800/424-8802
Center for Disease Control	404/488-4100
Chemtrec	800/424-9555
Illinois EPA Emergency Services	800/782-7860

#### **10.5 Emergency Medical Treatment Procedures**

For any person who becomes ill or injured, first aid should be administered while awaiting an ambulance or paramedics. All injuries and illnesses must be reported immediately to the project manager.

Any person being transported to a clinic or hospital for treatment should take with them information on the chemical(s) they have been exposed to at the site. This information is included in Tables 1 and 2.

Any vehicle used to transport contaminated personnel will be treated and cleaned as necessary.

#### **10.6 Fire or Explosion**

In the event of a fire or explosion, the local fire department should be summoned immediately. Upon their arrival, the project manager or designated alternate will advise the fire commander of the location, nature, and identification of the hazardous materials onsite.

If it is safe to do so, site personnel may:

- Use fire fighting equipment available onsite to control or extinguish the fire; and,



- Remove or isolate flammable or other hazardous materials which may contribute to the fire.

#### **10.7 Spill or Leaks**

In the event of a spill or a leak, site personnel will:

- Inform their supervisor immediately;
- Locate the source of the spillage and stop the flow if it can be done safely; and,
- Begin containment and recovery of the spilled materials.

The spill containment program procedures are presented in Appendix C.

#### **10.8 Emergency Equipment/Facilities**

Figure 2 is a map of the site facilities. The following emergency equipment is located in the main office onsite and where otherwise specified.

- |                        |                                    |
|------------------------|------------------------------------|
| • Telephone -          | warehouse                          |
| • Fire Extinguisher -  | warehouse, Return-and-Fill Station |
| • First Aid Kit -      | office, field vehicle              |
| • Emergency Eye Wash - | warehouse, Return-and-Fill Station |

#### **10.9 Encountering Chemical Impacts**

If an employee notices visibly obvious chemical impacts that was not anticipated prior to conducting the work activities, he/she should notify his/her supervisor immediately. The site supervisor will then confer with the project manager or other appropriate personnel.

**TABLE 1**  
**CHEMICALS DETECTED AT SAFETY-KLEEN, CHICAGO RECYCLE CENTER**

<b>Chemical</b>	<i>Maximum Detected Levels</i>	
	<b>Soils (mg/kg)</b>	<b>Groundwater (mg/L)</b>
Chloroform	---	50.0
Chloroethane	---	0.024
1,1-Dichloroethane	---	0.096
1,2-Dichloroethene (total)	---	0.021
Freon 113	5.9	---
Methylene chloride	26	9.5
1-Methyl-2-pyrrolidinone	310	---
B - Picoline	1400	---
Pyridine	3.5	---
Tetrachloroethene	55	---
1,1,1-Trichloroethane	2000	0.029
Trichloroethene	2800	0.028
Trichlorotrifluoroethane	6.3	---
Tetrahydrofuran	3.4	---
Toluene	44,000	470.0

Chemical name, structure/formula, CAS and RTECS Nos., and DOT ID and guide Nos.	Synonyms, trade names, and conversion factors	Exposure limits (TWA unless noted otherwise)	IDLH	Physical description	Chemical and physical properties		Incompatibilities and reactivities	Measurement method (See Table 1)	Personal protection and sanitation (See Table 3)	Recommendations for respirator selection—maximum concentration for use (MUC) (See Table 4)	Health hazards				
					MW, BP, SOL, FLP, IP, Sp.Gr., flammability	VP, FRZ, UEL, LEL					Route	Symptoms (See Table 5)	First aid (See Table 6)	Target organs (See Table 5)	
Sodium hydroxide NaOH 1310-73-2 WB4900000	Caustic soda, Lye, Soda lye, Sodium hydrate	NIOSH/OSHA C 2 mg/m <sup>3</sup>	250 mg/m <sup>3</sup>	Colorless to white, odorless solid (flakes, beads, granular form).	MW: 40.0 BP: 2534°F Sol: 111% FLP: NA IP: NA	VP: 0 mm (approx) MLT: 605°F UEL: NA LEL: NA	Water; acids; flammable liquids; organic halogens; metals such as aluminum, tin & zinc; nitromethane [Note: Corrosive to metals.]	Filter: HC: Titrate: III [#7401, Alkaline Dusts]	Clothing: Any poss Goggles: Any poss Wash: Immed contam Change: After work if reason prob contam Remove: Immed non-imperv contam Provide: Eyewash, quick drench	NIOSH/OSHA 50 mg/m <sup>3</sup> : PAPRDM/SA/CF 100 mg/m <sup>3</sup> : SCBAF/SAF/HIEF 250 mg/m <sup>3</sup> : SAF-PD, PP §: SCBAF-PD, PP/SAF-PD, PP-ASCBA Escape: HIEF/SCBAE	Inh Ing Con	Irrit nose; pneumitis; burns eyes, skin; temporary loss of hair	Eye: Skin: Breath: Swallow:	Irr immed Water flush immed Resp support Medical attention immed	Eyes, resp sys, skin
Standard solvent  8052-41-3 WJ8925000	Dry cleaning safety solvent, Mineral spirits, Petroleum solvent, Spotting naphtha	NIOSH 250 mg/m <sup>3</sup> C 1800 mg/m <sup>3</sup> [15-min]  OSHA 100 ppm (525 mg/m <sup>3</sup> )	29,500 mg/m <sup>3</sup>	Colorless liquid with a kerosene-like odor.	MW: Varies BP: 425-572°F Sol: Insoluble FLP: 110°F IP: ?	VP: ? FRZ: ? UEL: ? LEL: ?	Strong oxidizers:	Chart: CS: GC/FID: III [#1550]	Clothing: Repeat Goggles: Reason prob Wash: Reason prob Change: Prompt wet Remove: Prompt non-imperv wet	NIOSH 3500 mg/m <sup>3</sup> : SA/SCBA/CCRQV 5900 mg/m <sup>3</sup> : PAPRQV/CCRQV 8750 mg/m <sup>3</sup> : SA/CF 17,500 mg/m <sup>3</sup> : GMFOV/SCBAF/SAF 29,500 mg/m <sup>3</sup> : SAF-PD, PP §: SCBAF-PD, PP/SAF-PD, PP-ASCBA Escape: GMFOV/SCBAE	Inh Ing Con	Irrit eyes, nose, throat; dizziness; burn	Eye: Skin: Breath: Swallow:	Irr immed Soap wash prompt Resp support Medical attention immed	Skin, eyes, resp sys, CNS
1268 27 (petroleum distillate)					Sp.Gr: 0.78 Class II Combustible Liquid										
Tetrachloroethylene C <sub>2</sub> Cl <sub>4</sub> 127-18-4 KX3850000	Perchloroethylene, Perchloroethylene, Perk., Tetrachloroethylene	NIOSH Ca See Appendix A Minimize workplace exposure concentrations; limit number of workers exposed. OSHA 25 ppm (170 mg/m <sup>3</sup> )	Ca [500 ppm]	Colorless liquid with a mild, chloroform-like odor.	MW: 185.8 BP: 250°F Sol(77°F): 0.02% FLP: NA IP: 9.32 eV	VP: 14 mm FRZ: -2°F UEL: NA LEL: NA	Strong oxidizers; chemically-active metals such as lithium, beryllium & barium; caustic soda; sodium hydroxide; potash	Chart: CS: GC/FID: III [#1003, Halogenated Hydrocarbons]	Clothing: Repeat Goggles: Reason prob Wash: Reason prob Change: Prompt contam Remove: Prompt non-imperv contam	NIOSH Y: SCBAF-PD, PP/SAF-PD, PP-ASCBA Escape: GMFOV/SCBAE	Inh Ing Con	Irrit eyes, nose, throat; nau; flush face, neck; vert, dizz, inco; head, som; skin eryt; liver damage; (carc)	Eye: Skin: Breath: Swallow:	Irr immed Soap wash prompt Resp support Medical attention immed	Liver, kidneys, eyes, upper resp sys, CNS
1897 74	1 ppm = 6.89 mg/m <sup>3</sup>				Sp.Gr: 1.62 Noncombustible Liquid										
Tetrahydrofuran C <sub>4</sub> H <sub>8</sub> O 109-99-9 LU5950000	Diethylene oxide; 1,4-Epoxybutane; Tetramethylene oxide; THF	NIOSH/OSHA 200 ppm (590 mg/m <sup>3</sup> ) ST 250 ppm (735 mg/m <sup>3</sup> )	20,000 ppm [LEL]	Colorless liquid with an ether-like odor.	MW: 72.1 BP: 151°F Sol: Miscible FLP: 8°F IP: 9.45 eV	VP: 132 mm FRZ: -163°F UEL: 11.8% LEL: 2%	Strong oxidizers, lithium-aluminum alloys [Note: Peroxides may accumulate upon prolonged storage in presence of air.]	Chart: CS: GC/FID: III [#1609]	Clothing: Repeat Goggles: Reason prob Wash: Reason prob Change: Prompt wet Remove: Immed wet (flamm)	NIOSH/OSHA 1000 ppm: PAPRQV/CCRQV 5000 ppm: SA/CF 10,000 ppm: GMFOV/SCBAF/SAF 20,000 ppm: SAF-PD, PP §: SCBAF-PD, PP/SAF-PD, PP-ASCBA Escape: GMFOV/SCBAE	Inh Ing Con	Irrit eyes, upper resp sys; nau, dizz, head	Eye: Skin: Breath: Swallow:	Irr immed Water flush prompt Resp support Medical attention immed	Eyes, skin, resp sys, CNS
2056 26	1 ppm = 3.00 mg/m <sup>3</sup>				Sp.Gr: 0.89 Class IB Flammable Liquid										
Toluene C <sub>6</sub> H <sub>5</sub> CH <sub>3</sub> 108-88-3 XS5250000	Methyl benzene, Methyl benzol, Phenyl methane, Toluol	NIOSH/OSHA 100 ppm (375 mg/m <sup>3</sup> ) ST 150 ppm (560 mg/m <sup>3</sup> )	2000 ppm	Colorless liquid with a sweet, pungent, benzene-like odor.	MW: 92.1 BP: 232°F Sol(61°F): 0.05% FLP: 40°F IP: 8.82 eV	VP(65°F): 20 mm FRZ: -139°F UEL: 7.1% LEL: 1.2%	Strong oxidizers	Chart: CS: GC/FID: III [#1500, Hydrocarbons]	Clothing: Repeat Goggles: Reason prob Wash: Reason prob Change: Prompt wet Remove: Immed wet (flamm)	NIOSH/OSHA 1000 ppm: CCRQV/SA/PAPRQV/SCBA 2000 ppm: SA/CF/SCBAF/SAF/GMFOV §: SCBAF-PD, PP/SAF-PD, PP-ASCBA Escape: GMFOV/SCBAE	Inh Abs Ing Con	Flg, weak; conf, euph, dizz, head; dilated pupils, lac; ner, musc ftg, insom; pares; derm	Eye: Skin: Breath: Swallow:	Irr immed Soap wash prompt Resp support Medical attention immed	CNS, liver, kidneys, skin
1204 27	1 ppm = 3.83 mg/m <sup>3</sup>				Sp.Gr: 0.87 Class IB Flammable Liquid										
Trichloroethylene C <sub>2</sub> HCl <sub>3</sub> 79-01-6 KX4550000	Ethylene trichloride, Triclene, Trichloroethene	NIOSH Ca See Appendix A 25 ppm  OSHA 50 ppm (270 mg/m <sup>3</sup> ) ST 200 ppm (1080 mg/m <sup>3</sup> )	Ca [1000 ppm]	Colorless liquid (unless dyed blue) with a chloroform-like odor.	MW: 131.4 BP: 189°F Sol(77°F): 0.1% FLP: 90°F IP: 9.45 eV	VP: 58 mm FRZ: -99°F UEL(77°F): 10.5% LEL(77°F): 8%	Strong caustics & alkalis; chemically-active metals such as barium, lithium, sodium, magnesium, titanium & beryllium	Chart: CS: GC/FID: III [#1022]	Clothing: Repeat Goggles: Reason prob Wash: Reason prob Change: Prompt wet Remove: Prompt non-imperv wet	NIOSH Y: SCBAF-PD, PP/SAF-PD, PP-ASCBA Escape: GMFOV/SCBAE	Inh Ing Con	Head, vert; vis dist, tremors, som, nau, vomit; irrit eyes; derm; card arry, pares; (carc)	Eye: Skin: Breath: Swallow:	Irr immed Soap wash prompt Resp support Medical attention immed	Resp sys, heart, liver, kidneys, CNS, skin
1710 74	1 ppm = 5.46 mg/m <sup>3</sup>				Sp.Gr: 1.46 Class IC Flammable Liquid, but burns with difficulty.										
1,1,2-Trichloro-1,2,2-tetrafluoroethane CCl <sub>2</sub> FCFClF <sub>2</sub> 76-13-1 KJ4000000	Chlorofluorocarbon-113, CFC-113, Freon® 113, Genetron® 113, Halocarbon 113, Refrigerant 113, TTE	NIOSH/OSHA 1000 ppm (7600 mg/m <sup>3</sup> ) ST 1250 ppm (9500 mg/m <sup>3</sup> )	4500 ppm	Colorless to water-white liquid with an odor like carbon tetrachloride at high concentrations. [Note: A gas above 118°F.]	MW: 187.4 BP: 118°F Sol(77°F): 0.02% FLP: ? IP: 11.99 eV	VP: 285 mm FRZ: -31°F UEL: ? LEL: ?	Chemically-active metals such as calcium, powdered aluminum, zinc, magnesium & beryllium [Note: Decomposes if in contact with alloys containing >2% magnesium.]	Chart: CS: GC/FID: III [#1020]	Clothing: Repeat Goggles: Any poss Wash: Prompt wet Change: N.R. Remove: Prompt non-imperv wet	NIOSH/OSHA 4500 ppm: SA/SCBA §: SCBAF-PD, PP/SAF-PD, PP-ASCBA Escape: GMFOV/SCBAE	Inh Ing Con	Irrit throat, drow, derm; in animals: card arry	Eye: Skin: Breath: Swallow:	Irr immed Soap wash prompt Resp support Medical attention immed	Skin, heart
1 ppm = 7.79 mg/m <sup>3</sup>					Sp.Gr(77°F): 1.56 Noncombustible Liquid at ordinary temperatures, but the gas will ignite and burn weakly at 1256°F										

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TABLE 2: CHEMICAL/PHYSICAL HAZARDS  
for this Health and Safety Plan  
(see accompanying NIOSH Tables 1-6  
for explanations of abbreviations  
and symbols)



**NIOSH**  
**Table 1. — Codes for measurement methods**

Code	Method/reagent	Code	Method/reagent
<b>Collection method.*</b>			
Ambersorb Bag	Ambersorb® XE-347 tube	Sample work-up:	Carbon tetrachloride
Carbo-B	Gas collection bag		1,1,2-Trichloro-1,2,2-trifluoroethane
Char	Bubbler		Chloroform
Char (low-Ni)	Carbosieve® B tube		Methylene chloride
	Charcoal tube		Acetonitrile
	Charcoal tube (low nickel content)		Acetic acid
Char (pet)	Charcoal tube (petroleum-based)		Carbon disulfide
Chrom	Chromosorb tube		Dimethylformamide
Dry tube	Drying tube		Ferric chloride
Filter	Particulate filter		Hydrochloric acid
Florisl	Florisl® tube		Formic acid
G-chrom P	Gas-chrom P® tube		Nitric acid
Hydrar	Hydrar® sorbent tube		Hydrogen peroxide
Imp	Impinger		High-pressure liquid chromatography
Mol-sieve	Molecular sieve tube		Sulfuric acid
Porapak	Porapak® tube	(Continued)	
Si gel	Silica gel tube		
Tenax GC	Tenax® GC tube		
T-Sorb	Thermosorb® tube		
Vertical elut	Vertical elutriator		
XAD	XAD® tube		

\*In the chemical listing, an asterisk following an adsorbent tube code (e.g., Char\*, Si gel\*, XAD-2\*, etc.) indicates that a special coating must be added. The figure "2" in parentheses following a collection device (e.g., Filter(2), Imp(2), Char(2), etc.) indicates that two are used in series.

NIOSH

**Table 1. — Codes for measurement methods (Continued)**

Code	Method/reagent	Code	Method/reagent
<b>Sample work-up (continued):</b>			
NaOH	Sodium hydroxide	GC/PID	GC with photoionization detection
NH <sub>4</sub> OH	Ammonium hydroxide	GC/TEA	GC with thermal energy analyzer
Pho-acid	Phosphomolybdic acid	Grav	Gravimetric
Thermal desorp	Thermal desorption apparatus	HGA	Flameless atomic absorption with a high-temperature graphite analyzer
THF	Tetrahydrofuran	HP/LC/FLD	High-pressure liquid chromatography with fluorescence detection
<b>Analytical method:</b>			
AA	Atomic absorption spectrometry	HP/LC/UV/D	High-pressure liquid chromatography with ultraviolet detection
ECA	Electrochemical analysis	IC	Ion chromatography
GC	Gas chromatography	ICP	Inductively coupled plasma
GC/AIK/FID	GC with alkaline flame ionization detection	IR	Infrared spectrometry
GC/ECD	GC with electron capture detection	ISE	Ion-specific electrode
GC/EConD	GC with electrolytic conductivity detection	PCM	Phase contrast microscopy
GC/FID	GC with flame ionization detection	PES	Plasma emission spectroscopy
GC/FPD	GC with flame photometric detection for sulfur, nitrogen, or phosphorus	PLR	Polarography
		Titrate	Titration
GC/NPD	GC with nitrogen/phosphorus detection	Vis	Visible spectrophotometry
		XRF	X-ray fluorescence spectrometry
		XRD	X-ray diffraction spectrometry

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**Table 2. — Ordering information for measurement methods**

Manual	Publication No.	Ordering No.	Manual	Publication No.	Ordering No.	
NIOSH Manual of Analytical Methods, 2nd edition:	Vol. I	NIOSH 77-157-A	PB-274-845	Supplement to 3rd edition	NIOSH 85-117	PB-86-116-266
	Vol. II	NIOSH 77-157-B	PB-276-624			
	Vol. III	NIOSH 77-157-C	PB-276-838			
	Vol. IV	NIOSH 78-175	PB-83-105-437	2nd supplement to 3rd edition	NIOSH 87-117	PB-88-204-722
	Vol. V	NIOSH 79-141	PB-83-105-445			
	Vol. VI	NIOSH 80-125	PB-82-157-728			
	Vol. VII	NIOSH 82-100	PB-83-105-452	3rd supplement to 3rd edition	NIOSH 89-127	PB-90-162-470
NIOSH Manual of Analytical Methods, 3rd edition	NIOSH 84-100	PB-85-179-018	OSHA Analytical Methods Manual, 1985 edition	—	4540*, 4541 (fiche)*	

\* Denotes ordering number of the American Conference of Governmental Industrial Hygienists (ACGIH), 6500 Glenway Ave., Building D-7, Cincinnati, OH 45211 (513-661-7881). All other ordering numbers are for the National Technical Information Service (NTIS), Springfield, VA 22161 (703-487-4650).

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NIOSH  
Table 3. — Personal protection and sanitation codes

Code	Definition
CLOTHING .....	Wear appropriate equipment to prevent:
Any poss liq/Repeat vap .....	Any possibility of liquid contact and repeated or prolonged vapor contact with skin
Any poss .....	Any possibility of skin contact
Any poss wet .....	Any possibility that skin will become wet with contaminant
Any poss >x%/Repeat y% .....	Any possibility of skin contact with liquids containing >x% of contaminant and repeated or prolonged skin contact with liquids containing y%
Any poss pH <x/Repeat pH >x .....	Any possibility of skin contact with solutions having a pH <x and repeated or prolonged skin contact with solutions having a pH >x
Prevent skin freezing .....	Self explanatory
Prevent contam or freezing .....	Contamination or freezing of skin
Prevent wet or freezing .....	Wetting or freezing of skin
Repeat .....	Repeated or prolonged skin contact
Reason prob .....	Reasonable probability of skin contact
GOGGLES .....	Wear eye protection to prevent:
Any poss .....	Any possibility of eye contact
Any poss >x%/	Any possibility of eye contact with liquids containing >x% of contaminant and reasonable probability of eye contact with liquid containing <y%
Reason prob <y% .....	Any possibility of eye contact with substance in a molten form and reasonable probability of eye contact with a liquid or solid containing the substance
Any poss molt/	Any possibility that substance xxx will contact the eyes
Reason prob liq-sol .....	
Any poss (xxx) .....	

(Continued)

NIOSH  
Table 3. — Personal protection and sanitation codes (Continued)

Code	Definition
GOGGLES (Continued)	
Reason prob .....	Reasonable probability of eye contact
Repeat .....	Repeated or prolonged eye contact
WASH .....	Workers should wash:
Daily .....	At the end of each work shift
Daily (reason prob) .....	At the end of each work shift when there is reasonable probability of contact with the contaminant
Immed contam .....	Immediately when skin becomes contaminated
Immed contam >x%/	Immediately when skin is contaminated with liquids containing >x% contaminant and promptly when skin is contaminated with y%
Prompt contam y% .....	
Immed contam >x%/	Immediately when skin is contaminated with liquids containing >x% contaminant and promptly when skin becomes wet with y%
Prompt wet y% .....	Immediately when skin becomes contaminated and at the end of each work shift
Immed contam/daily .....	
Immed contam pH <x/	Immediately when skin becomes contaminated with liquid of pH <x and promptly when skin becomes wet with liquid of pH >x
Prompt wet pH >x .....	Immediately when skin becomes wet and promptly when skin becomes contaminated
Immed wet .....	Immediately when skin becomes wet, promptly when skin becomes contaminated, and at the end of each work shift
Immed wet/Prompt contam .....	
Immed wet/Prompt contam/daily .....	

(Continued)

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Table 4. — Symbols, code components, and codes used for respirator selection

Item	Definition
<b>Symbol:</b>	
¥	At any detectable concentration
\$	Emergency or planned entry into unknown concentrations or IDLH conditions
E	Substance causes eye irritation or damage; eye protection needed
*	Substance reported to cause eye irritation or damage; may require eye protection if not present as a fume
Λ	Only nonoxidizable sorbents are allowed (not charcoal)
¿	End of service life indicator (ESLI) required
†	Assigned protection factor
APF	
<b>Code component:</b>	
CCR	Chemical cartridge respirator
D	Dust respirator (if an independent code); or a dust filter
F	Full facepiece
Fu	Fume filter
GMF	Air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted canister
M	Mist filter
PAPR	Powered, air-purifying respirator
SA	Supplied-air respirator
SCBA	Self-contained breathing apparatus
AG	Acid gas cartridge or canister
CF	Continuous flow mode

(Continued)

## NIOSH

Table 4. — Symbols, code components, and codes used for respirator selection (Continued)

Item	Definition
<b>Code component (continued):</b>	
HIE	Air-purifying respirator with a high-efficiency particulate filter (if an independent code); or a high-efficiency particulate filter
HIEF	Air-purifying, full-facepiece respirator with a high-efficiency particulate filter
OV	Organic vapor cartridge or canister
PD,PP	Pressure-demand or other positive-pressure mode
S	Chemical cartridge or canister providing protection against the compound of concern
T	Tight-fitting facepiece
XS	Except single-use respirator
XSQ	Except single-use and quarter-mask respirator
<b>Code:</b>	
CCRFAGHIE (APF = 50)	Any chemical cartridge respirator with a full facepiece and acid gas cartridge(s) in combination with a high-efficiency particulate filter
CCRFQV (APF = 50)	Any chemical cartridge respirator with a full facepiece and organic vapor cartridge(s)
CCRFQVDMFu (APF = 50)	Any chemical cartridge respirator with a full facepiece and organic vapor cartridge(s) in combination with a dust, mist, and fume filter
CCRFQVHIE (APF = 50)	Any chemical cartridge respirator with a full facepiece and organic vapor cartridge(s) in combination with a high-efficiency particulate filter
CCRFES (APF = 50)	Any chemical cartridge respirator with a full facepiece and cartridge(s) providing protection against the compound of concern
CCRFESHIE (APF = 50)	Any chemical cartridge respirator with a full facepiece and cartridge(s) providing protection against the compound of concern and having a high-efficiency particulate filter

(Continued)

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Table 3. — Personal protection and sanitation codes (Continued)

Code	Definition
<b>REMOVE (Continued)</b>	
Immed non-imperv wet/	
prompt non-imperv contam . . . . .	Immediately if it is non-impervious clothing that becomes wet and promptly if it is non-impervious clothing that becomes contaminated
Prompt non-imperv contam . . . . .	Promptly if it is non-impervious clothing that becomes contaminated
Prompt non-imperv wet . . . . .	Promptly if it is non-impervious clothing that becomes wet
<b>PROVIDE</b>	
The following equipment should be available:	
Eyewash . . . . .	Self-explanatory
Quick drench . . . . .	Self-explanatory
Eyewash (xxx) . . . . .	Eyewash if substance xxx is present
Eyewash >x% . . . . .	Eyewash if liquids containing >x% of contaminant are present
<b>OTHER CODES</b>	
Liq . . . . .	Liquid
Molt . . . . .	Molten
N.R. . . . .	No recommendation applies in this category
Sol . . . . .	Solid
Soln . . . . .	Solution containing the contaminant
Vap . . . . .	Vapor

NIOSH  
Table 3. — Personal protection and sanitation codes (Continued)

Code	Definition
<b>WASH (Continued)</b>	
Prompt contam . . . . .	Promptly when skin becomes contaminated
Prompt contam/daily . . . . .	Promptly when skin becomes contaminated and at the end of each work shift
Prompt wash soap . . . . .	Promptly wash with soap when skin becomes contaminated
Prompt wet . . . . .	Promptly when skin becomes wet
<b>CHANGE</b>	
Work clothing should be changed daily:	
After work if any poss contam . . . . .	If there is any possibility that the clothing may be contaminated
After work if reason prob contam . . . . .	If it is reasonably probable that the clothing may be contaminated
<b>REMOVE</b>	
Remove clothing:	
Immed contam . . . . .	Immediately if it becomes contaminated
Immed wet . . . . .	Immediately if it becomes wet
Immed wet (flamm) . . . . .	Immediately if it becomes wet (to avoid flammability hazard)
Immed wet/immed	
non-imperv contam . . . . .	Immediately if it becomes wet or if it is non-impervious clothing that becomes contaminated
Immed non-imperv contam . . . . .	Immediately if it is non-impervious clothing that becomes contaminated
Immed non-imperv contam >x%/	
Prompt non-imperv contam y% . . . . .	Immediately if it is non-impervious clothing that becomes contaminated with liquids containing >x% of contaminant and promptly if clothing is contaminated with y% (Continued)

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**Table 4. — Symbols, code components, and codes used for respirator selection (Continued)**

Item	Definition
Code (continued):	
CCROV (APF = 10) .....	Any chemical cartridge respirator with organic vapor cartridge(s)
CCROVAG (APF = 10) .....	Any chemical cartridge respirator with organic vapor and acid gas cartridge(s)
CCROVDM (APF = 10) .....	Any chemical cartridge respirator with organic vapor cartridge(s) in combination with a dust and mist filter
CCROVDMFu (APF = 10) .....	Any chemical cartridge respirator with organic vapor cartridge(s) in combination with a dust, mist, and fume filter
CROVHIE (APF = 10) .....	Any chemical cartridge respirator with organic vapor cartridge(s) in combination with a high-efficiency particulate filter
CCRS (APF = 10) .....	Any chemical cartridge respirator with cartridge(s) providing protection against the compound of concern
D (APF = 5) .....	Any dust respirator
DM (APF = 5) .....	Any dust and mist respirator
DMF (APF = 10) .....	Any dust and mist respirator with a full facepiece
DMFu (APF = 10) .....	Any dust, mist, and fume respirator
DMXSQ (APF = 10) .....	Any dust and mist respirator except single-use and quarter-mask respirators
DXSQ (APF = 10) .....	Any dust respirator except single-use and quarter-mask respirators
GMFAG (APF = 50) .....	Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted acid gas canister
GMFAGHIE (APF = 50) .....	Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted acid gas canister having a high-efficiency particulate filter
GMFOV (APF = 50) .....	Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister

(Continued)

# NIOSH

**Table 4. — Symbols, code components, and codes used for respirator selection (Continued)**

Item	Definition
Code (continued):	
GMFOVAG (APF = 50) .....	Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor and acid gas canister
GMFOVAGHIE (APF = 50) .....	Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor and acid gas canister having a high efficiency particulate filter
GMFOVDMFu (APF = 50) .....	Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister in combination with a dust, mist, and fume filter
GMFOVHIE (APF = 50) .....	Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having a high-efficiency particulate filter
GMFS (APF = 50) .....	Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted canister providing protection against the compound of concern
GMFSHIE (APF = 50) .....	Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted canister providing protection against the compound of concern and having a high-efficiency particulate filter
HIE (APF = 10) .....	Any air-purifying respirator with a high-efficiency particulate filter
HIEF (APF = 50) .....	Any air-purifying, full-facepiece respirator with a high-efficiency particulate filter
PAPRAG (APF = 25) .....	Any powered, air-purifying respirator with acid gas cartridge(s)
PAPRAGHIE (APF = 25) .....	Any powered, air-purifying respirator with acid gas cartridge(s) in combination with a high-efficiency particulate filter
PAPRO (APF = 25) .....	Any powered, air-purifying respirator with a dust filter
PAPRDM (APF = 25) .....	Any powered, air-purifying respirator with a dust and mist filter
PAPRDMFu (APF = 25) .....	Any powered, air-purifying respirator with a dust, mist, and fume filter

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**Table 4. — Symbols, code components, and codes used for respirator selection (Continued)**

Item	Definition
Code (continued):	
PAPRHIE (APF = 25) .....	Any powered, air-purifying respirator with a high-efficiency particulate filter
PAPROV (APF = 25) .....	Any powered, air-purifying respirator with organic vapor cartridge(s)
PAPROVAG (APF = 25) .....	Any powered, air-purifying respirator with organic vapor and acid gas cartridge(s)
PAPROVDM (APF = 25) .....	Any powered, air-purifying respirator with organic vapor cartridge(s) in combination with a dust and mist filter
PAPROVDMFu (APF = 25) .....	Any powered, air-purifying respirator with organic vapor cartridge(s) in combination with a dust, mist, and fume filter
PAPRS (APF = 25) .....	Any powered, air-purifying respirator with cartridge(s) providing protection against the compound of concern
PAPRTHIE (APF = 50) .....	Any powered, air-purifying respirator with a tight-fitting facepiece and a high-efficiency particulate filter
PAPRTOV (APF = 50) .....	Any powered, air-purifying respirator with a tight-fitting facepiece and organic vapor cartridge(s)
PAPRTOVHIE (APF = 50) .....	Any powered, air-purifying respirator with a tight-fitting facepiece and organic vapor cartridge(s) in combination with a high-efficiency particulate filter
PAPRTS (APF = 50) .....	Any powered, air-purifying respirator with a tight-fitting facepiece and cartridge(s) providing protection against the compound of concern
SA (APF = 10) .....	Any supplied-air respirator
SA:CF (APF = 25) .....	Any supplied-air respirator operated in a continuous-flow mode
SAF (APF = 50) .....	Any supplied-air respirator with a full facepiece
SAF:PD,PP (APF = 2000) .....	Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode

(Continued)

# NIOSH

**Table 4. — Symbols, code components, and codes used for respirator selection (Continued)**

Item	Definition
Code (continued):	
SAF:PD,PP:ASCSBA (APF = 10,000) .....	Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode
SA:PD,PP (APF = 1000) .....	Any supplied-air respirator operated in a pressure-demand or other positive-pressure mode
SAT:CF (APF = 50) .....	Any supplied-air respirator that has a tight-fitting facepiece and is operated in a continuous-flow mode
SCBA (APF = 10) .....	Any self-contained breathing apparatus
SCBAE .....	Any appropriate escape-type, self-contained breathing apparatus
SCBAF (APF = 50) .....	Any self-contained breathing apparatus with a full facepiece
SCBAF:PD,PP (APF = 10,000) .....	Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode

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## Table 5. — Abbreviations for symptoms of exposure and target organs

Abbreviation	Symptom/organ	Abbreviation	Symptom/organ
abdom	Abdominal	convuls	Convulsions
album	Albuminuria	CVS	Cardiovascular system
anes	Anesthesia	cyan	Cyanosis
anor	Anorexia	depres	Depressant/depression
anos	Anosmia	derm	Dermatitis
appre	Apprehension	diarr	Diarrhea
arthr	Arthritias	dist	Disturbance
asphy	Asphyxia	dizz	Dizziness
BP	Blood pressure	drow	Drowsiness
breath	Breathing	dysp	Dyspnea
bron	Bronchitis	emphy	Emphysema
broncopneu	Bronchopneumonia	eosin	Eosinophilia
bronspas	Bronchospasm	epis	Epistaxis
BUN	Blood urea nitrogen	equi	Equilibrium
[carc]	Carcinogen	eryt	Erythema
card	Cardiac	euph	Euphoria
chol	Cholinesterase	fail	Failure
cirr	Cirrhosis	fasc	Fasciculation
CNS	Central nervous system	FEV	Forced expiratory volume
conf	Confusion	fib	Fibrosis
conj	Conjunctivitis	fibril	Fibrillation
constip	Constipation	fig	Fatigue
constrict	Constriction	func	Function

(Continued)

# NIOSH

## Table 5. — Abbreviations for symptoms of exposure and target organs (Continued)

Abbreviation	Symptom/organ	Abbreviation	Symptom/organ
GI	Gastrointestinal	leupen	Leukopenia
gidd	Giddiness	li-head	Lignttheadedness
halu	Hallucinations	low-wgt	Weight loss
head	Headache	mal	Malaise
hemato	Hematopoietic	malnut	Malnutrition
hemog	Hemoglobinuria	monocy	Monocytosis
hemorr	Hemorrhage	muc memb	Mucous membrane
hypox	Hypoxemia	muscle	Muscle
incr	Increase(d)	narco	Narcosis
icter	Icterus	nau	Nausea
inco	Incoordination	nec	Necrosis
inflamm	Inflammation	neph	Nephritis
inj	Injury	ner	Nervousness
insom	Insomnia	numb	Numbness
irreg	Irregular	opac	Opacity
irrit	Irritation	palp	Palpitations
irrity	Irritability	para	Paralysis
jaun	Jaundice	pareas	Paresthesia
kera	Keratitis	perf	Perforation
lac	Lacrimation	peri neur	Peripheral neuropathy
lar	Laryngeal	periorb	Periorbital
lass	Lassitude	phar	Pharyngeal
leucyt	Leukocytosis	photo	Photophobia

(Continued)

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**Table 5. — Abbreviations for symptoms of exposure and target organs (Continued)**

Abbreviation	Symptom/organ	Abbreviation	Symptom/organ
pig .....	Pigmentation	subs .....	Substernal
pneu .....	Pneumonia	sweat .....	Sweating
pneutis .....	Pneumonitis	swell .....	Swelling
PNS .....	Peripheral nervous system	sys .....	System
polynEUR .....	Polyneuropathy	tacar .....	Tachycardia
prot .....	Proteinuria	tend .....	Tenderness
pulm .....	Pulmonary	trachbronc .....	Tracheobronchitis
RBC .....	Red blood cell	ventib .....	Ventricular fibrillation
resp .....	Respiratory	verti .....	Vertigo
retster .....	Retrosternal	vesic .....	Vesiculation
rhin .....	Rhinorrhea	vis dist .....	Visual disturbance
salv .....	Salivation	vomit .....	Vomiting
sens .....	Sensitization	weak .....	Weakness
sez .....	Seizure	wheez .....	Wheezing
som .....	Somnolence		

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Table 6. — Codes for first aid data

Code	Definition	Code	Definition
Eye: Irr irritated .....	If this chemical contacts the eyes, immediately wash the eyes with large amounts of water, occasionally lifting the lower and upper lids. Get medical attention immediately. Contact lenses should not be worn when working with this chemical.	Medical attention ...	Self-explanatory
Irr irritated (15 min) ..	If this chemical contacts the eyes, immediately wash the eyes with large amounts of water and continue flushing for 15 minutes, occasionally lifting the lower and upper lids. Get medical attention immediately. Contact lenses should not be worn when working with this chemical.	Skin: Dust off solid; water flush .....	If this solid chemical contacts the skin, dust it off immediately and then flush the contaminated skin with water. If this chemical or liquids containing this chemical penetrate the clothing, promptly remove the clothing and flush the skin with water. Get medical attention immediately.
Irr prompt .....	If this chemical contacts the eyes, promptly wash the eyes with large amounts of water, occasionally lifting the lower and upper lids. Get medical attention if any discomfort continues. Contact lenses should not be worn when working with this chemical.	Medical attention for frostbite .....	If this chemical contacts the skin or mouth, stop the exposure immediately. If frostbite has occurred, get medical attention.
		Molten flush irritated/ sol-liq soap wash prompt ....	If this molten chemical contacts the skin, immediately flush the skin with large amounts of water. Get medical attention immediately. If this chemical

(Continued)

# NIOSH

Table 6. — Codes for first aid data (Continued)

Code	Definition	Code	Definition
Skin (continued):			
	cal (or liquids containing this chemical) contacts the skin, promptly wash the contaminated skin with soap and water. If this chemical or liquids containing this chemical penetrate the clothing, immediately remove the clothing and wash the skin with soap and water. If irritation persists after washing, get medical attention.	Soap prompt/molten flush irritated .....	move the clothing and flush the skin with water. If irritation persists after washing, get medical attention.
Soap flush irritated .....	If this chemical contacts the skin, immediately flush the contaminated skin with soap and water. If this chemical penetrates the clothing, immediately remove the clothing and flush the skin with water. If irritation persists after washing, get medical attention.	Soap wash .....	If this solid chemical or a liquid containing this chemical contacts the skin, promptly wash the contaminated skin with soap and water. If irritation persists after washing, get medical attention. If this molten chemical contacts the skin or nonimpervious clothing, immediately flush the affected area with large amounts of water to remove heat. Get medical attention immediately.
Soap flush prompt ..	If this chemical contacts the skin, promptly flush the contaminated skin with soap and water. If this chemical penetrates the clothing, promptly re-	Soap wash irritated .....	If this chemical contacts the skin, wash the contaminated skin with soap and water.
			If this chemical contacts the skin, immediately wash the contaminated skin with soap and water. If this chemical penetrates the clothing,

(Continued)

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## Table 6. — Codes for first aid data (Continued)

Code	Definition	Code	Definition
Skin (continued):		Fresh air; 100% O <sub>2</sub> .....	If a person breathes large amounts of this chemical, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. When breathing is difficult, properly trained personnel may assist the affected person by administering 100% oxygen. Keep the affected person warm and at rest. Get medical attention as soon as possible.
Breath:		Swallow:	
Resp support .....	If a person breathes large amounts of this chemical, move the exposed person to fresh air at once. If breathing has stopped, perform mouth-to-mouth resuscitation. Keep the affected person warm and at rest. Get medical attention as soon as possible.	Medical attention immed . . .	If this chemical has been swallowed, get medical attention immediately.
Fresh air .....	If a person breathes large amounts of this chemical, move the exposed person to fresh air at once. Other measures are usually unnecessary.		

# NIOSH

## Table 6. — Codes for first aid data (Continued)

Code	Definition	Code	Definition
Skin (continued):		Water flush prompt .....	If this chemical contacts the skin, flush the contaminated skin with water promptly. If this chemical penetrates the clothing, immediately remove the clothing and flush the skin with water. If irritation persists after washing, get medical attention.
Soap wash prompt .....	If this chemical contacts the skin, promptly wash the contaminated skin with soap and water. If this chemical penetrates the clothing, promptly remove the clothing and wash the skin with soap and water. Get medical attention promptly.	Water wash immed .....	If this chemical contacts the skin, immediately wash the contaminated skin with water. If this chemical penetrates the clothing, immediately remove the clothing and wash the skin with water. If symptoms occur after washing, get medical attention immediately.
Water flush .....	If this chemical contacts the skin, flush the contaminated skin with water. Where there is evidence of skin irritation, get medical attention.	Water wash prompt .....	If this chemical contacts the skin, promptly wash the contaminated skin with water. If this chemical penetrates the clothing, promptly remove the clothing and wash the skin with water. Get medical attention promptly.
Water flush immed .....	If this chemical contacts the skin, immediately flush the contaminated skin with water. If this chemical penetrates the clothing, immediately remove the clothing and flush the skin with water. Get medical attention promptly.		

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TABLE 3

**EMERGENCY RECOGNITION/CONTROL MEASURES**

<u>Specific Hazard</u>	<u>Prevention/Control</u>
Fire/Explosion	Fire extinguisher
Spill/Leak	Berms/Dikes Absorbent Material Foams



**APPENDIX A:**

**TASK HAZARD DESCRIPTIONS AND GENERAL SAFETY RULES**

## **SURFACE AND SUBSURFACE SOIL SAMPLING**

For the purposes of hazard identification, surface and subsurface soil sampling will be considered any soil sampling completed by hand using a trowel, split spoon, shovel, auger or other type of handheld tool. Hazards generally associated with soil and tailings/spoils sampling include:

- Contact with or inhalation of chemicals, potentially in high concentrations in sampling media.
- Back strain and muscle fatigue due to lifting, shoveling and augering techniques.
- Contact with or inhalation of decontamination solutions.

## **HAZARD PREVENTION**

- To minimize exposure to chemicals, a thorough review of suspected chemicals should be completed along with implementation of an adequate protection program.
- Proper lifting (pre-lift weight assessment, use of legs, multiple personnel) techniques will prevent back strain. Use slow easy motions when shoveling, augering and digging to decrease muscle strain.
- Material Safety Data Sheets for all decon solutions should be included with each Site Health and Safety Plan.
- First aid equipment should be available based on MSDS requirements.

## **SOIL BORINGS AND MONITORING WELL INSTALLATION**

Hazards generally associated with drilling operations include the following:

- Noise levels exceeding the OSHA PEL of 90 dBA are both a hazard and a hindrance to communication.
- Fumes (carbon monoxide) from the drill rig.
- Overhead utility wires, i.e. electrical and telephone, can be hazardous when the drill rig boom is in the upright position.
- Underground pipelines and utility lines can be ruptured or damaged during active drilling operations.
- Moving parts, i.e. augers, on the drill rig may catch clothing. Free or falling parts from the cat head may cause head injury.
- Moving the drill rig over uneven terrain may cause the vehicle to roll over or get stuck in a rut or mud. Be aware of hazards associated with moving heavy machinery and other associated injury.
- High pressure hydraulic lines and air lines used on drill rigs are hazardous when they are in ill repair or incorrectly assembled.
- Vehicular traffic may be excessive, particularly on small sites or on public property.

## **HAZARD PREVENTION**

- Review the chemicals suspected to be onsite and perform air monitoring as required. Shut down the drill rig and/or divert exhaust fumes.
- All chains, lines, cables should be inspected daily for weak spots, frays, etc.
- Ear muffs and ear plugs effectively reduce noise levels.
- Hardhats should be worn at all times when working around a drill rig. Secure loose clothing. Check boom prior to approaching the drill rig.
- To avoid contact with any overhead lines, the drill rig boom should be lowered prior to moving the rig. Overhead utilities should be considered "live" until determined otherwise.
- The rig mast should not be erected within 30 feet of an overhead electrical line until the line is deenergized, grounded, or shielded and an electrician has certified that arcing cannot occur.

- Minimum working distances around "live" overhead power lines are:

Voltage Range (kilovolt)	Minimum Working Distance
2.1 to 15	2 ft. 0 in
15.1 to 35	2 ft. 4 in
35.1 to 46	2 ft. 6 in
46.1 to 72.5	3 ft. 0 in
72.6 to 121	3 ft. 0 in
138 to 145	3 ft. 6 in
161 to 169	3 ft. 8 in
230 to 242	5 ft. 0 in
345 to 362	7 ft. 0 in
500 to 552	11 ft. 0 in
700 to 765	15 ft. 0 in

- A thorough underground utilities search should be conducted before the commencement of a drilling project.
- All high pressure lines should be checked prior to and during use.
- Caution tape, safety cones and signs should delineate clearly those areas where work will be performed. Only authorized personnel should be allowed to enter demarcated zones.

## **GROUNDWATER SAMPLING**

Hazards generally encountered during groundwater sampling include the following:

- Exposure to vapors of volatile organics when the well head is initially opened.
- Back strain due to lifting bailers or pumps from down-well depths and moving equipment (generators) to well locations.
- Electrical hazards associated with use of electrical equipment around water or wet surfaces.
- Possible water splashing in eyes during sampling.
- Vehicular traffic may be excessive, particularly on small sites or on public property.

## **HAZARD PREVENTION**

- To minimize exposure to volatiles when the well head is initially opened, a monitor instrument (HNU, OVA) should be placed near the opening to monitor organic levels. The breathing zone should also be monitored. The action levels on the instruments should be chosen according to the health and safety plan. To prevent contact with impacted groundwater, or product material, provide adequate protective equipment.
- Back strain can be prevented by employing proper lifting and bailing techniques. Heavy equipment, such as pumps and generators, should only be lifted with the legs, preferable using two or three personnel.
- Slipping on wet surfaces can be prevented by placing all purged water in drums for removal. Also, if the area is wet wear boots with good treads and be alert of where personnel are walking to decrease the chance of slipping.
- Ground fault interrupter should be used in the absence of properly grounded circuitry or when pumps are used around wet conditions.
- Electrical extension cords should be protected or guarded from damage (i.e. cuts from other machinery) and be maintained in good condition.
- Eye protection should be worn as appropriate to prevent water splashing into eyes.
- Caution tape, safety cones and signs should delineate clearly those areas where work will be performed. Only authorized personnel should be allowed to enter demarcated zones.

## **GENERAL SAFETY RULES**

1. On sites involving hazardous materials, eating, drinking, chewing gum and chewing tobacco will be allowed only in designated areas. All personnel are required to wash their hands and face immediately after completing work activities in an exclusionary zone.
2. Each employee shall comply with the safety rules, regulations, and orders which apply to his own actions and conduct, and shall not interfere with any method or process adopted for protection of any employee on any company property or project.
3. Never work alone in an isolated area unless arrangements have been made for periodic contact with another employee.
4. Watch for fire hazards. Know the location and operation for the fire extinguisher in your area. Check with your supervisor if in doubt. Report any fire extinguishers that are partly empty or otherwise inoperative.
5. Employees must not tamper with or attempt any unauthorized repair to any equipment.
6. Do not start any machinery without first personally making certain that no one can be injured by the operation.
7. Never move any piece of equipment without first checking completely around it to see that it is safe to do so.
8. Keep out of areas that are barricaded or marked restricted. There may be work going on or conditions that expose you to danger.
9. Practice lifting properly. Lift with your legs, not your back. Do not try to lift more than you can handle. Get help if the load is too heavy or awkward to handle safely.
10. If you are in doubt about the safe or proper way to do any job, get instructions from your foreman.
11. Any condition which you feel is unsafe should be reported to your foreman or other responsible person.
12. Riding on loads, hooks, buckets, hammers, or material hoists is prohibited.
13. Do not enter any confined space until the area has been cleared by a supervisor or safety officer. Confined spaces may include, but are not limited to, sewers, sumps, manholes and trenches.
14. Getting on or off any vehicle while it is in motion is prohibited.
15. Horseplay is strictly forbidden.
16. Do not use defective handtools. Watch for broken or loose handles and mushroomed heads and report them to your foreman. Always use the right tool for the job.
17. Use the guards provided for all power tools. Do not use any equipment if the guard is broken, inoperative, or missing.

18. Unsafe conditions, acts, or equipment must be promptly corrected and/or reported to your foreman so that corrective action may be taken.
19. Report all accidents and injuries to the supervisor or project manager. Even minor injuries requiring only on-site first aid must be reported.
20. USE GOOD JUDGEMENT IN DOING YOUR WORK. DO NOT TAKE UNNECESSARY CHANCES.

**APPENDIX B:**

**STANDARD OPERATING PROCEDURES FOR PERSONAL  
PROTECTIVE CLOTHING AND EQUIPMENT**



## **I. STANDARD OPERATING PROCEDURES FOR PERSONAL PROTECTIVE CLOTHING**

Proper inspection of PPE features several sequences of inspection depending upon specific articles of PPE and its frequency of use. The different levels of inspection are as follows:

Inspection and operational testing of equipment received from the factory or distributor.  
Inspection of equipment as it is issued to workers.  
Inspection after use or training and prior to maintenance.  
Periodic inspection of stored equipment.  
Periodic inspection when a question arises concerning the appropriateness of the selected equipment, or when problems with similar equipment arise.

The primary inspection of PPE in use for activities at the Site will occur prior to immediate use and will be conducted by the user. This ensures that the specific device or article has been checked out by the user, and that the user is familiar with its use.

### **SAMPLE PPE INSPECTION CHECKLISTS**

#### **CLOTHING**

Before use:

- Determine that the clothing material is correct for the specified task at hand.
- Visually inspect for:
  - imperfect seams
  - non-uniform coatings
  - tears
  - malfunctioning closures
- Hold up to light and check for pinholes.
- Flex product
  - observe for cracks
  - observe for other signs of shelf deterioration
- If the product has been used previously, inspect inside and out for signs of chemical attack.

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- discoloration
- swelling
- stiffness

During the work task, periodically inspect for:

- Evidence of chemical attack such as discoloration, swelling, stiffening, and softening. Keep in mind, however, that chemical permeation can occur without any visible defects.
- Closure failure
- Tears
- Punctures
- Seam Discontinuities

## **GLOVES**

Before use:

- Visually inspect for:
  - imperfect seams
  - tears, abrasions
  - non-uniform coating
  - pressurize glove with air, listen for pinhole leaks.

## **II. STANDARD OPERATING PROCEDURES FOR RESPIRATORY PROTECTION DEVICES**

The following subsections define standard operating procedures for air purifying respirators and self-contained breathing apparatus.

### **A. Cleaning and Disinfecting Self Contained Breathing Apparatus**

Cleaning procedures for Self Contained Breathing Apparatus (SCBA) facepieces are identical to those for Ultratwin APRs. The backpiece is cleaned with cleaning solution and a brush. Following cleaning, the facepiece is combined with the regulator and an operational check is performed.

### **B. SCBA Inspection and Checkout**

Monthly Inspection:

- I. Check cylinder label for current hydrostatic test date.

2. Inspect cylinder for large dents or gouges.
  3. Inspect cylinder gauge for damage.
  4. Complete routine inspection.
  5. Fill out the appropriate records with results and recommendations.
- Routine Inspection:

Perform immediately prior to donning or after cleaning.

1. Before proceeding, check that the:
  - High-pressure hose connector is tight on cylinder fitting.
2. Backpack and harness assembly:
  - Visually inspect straps for wear, damage, and completeness.
  - Check wear and function of belt
  - Check backplate and cylinder holder for damage.
3. Cylinder and high pressure hose assembly:
  - Check cylinder to assure that it is firmly attached to backplate.
  - Open cylinder valve; listen or feel for leakage around packing and hose connection.
  - Check high pressure hose for damage or leaks.
4. Regulator
  - Cover regulator outlet with palm of hand.
  - Open mainline valve.
  - Note stoppage of air flow after positive pressure builds.
  - Close mainline valve.
  - Remove hand from regulator outlet.

- Open by-pass valve slowly to assure proper function.
  - Close by-pass valve.
  - Open mainline valve.
  - Note pressure reading on regulator gauge.
  - Close cylinder valve while keeping hand over regulator outlet.
  - Slowly remove hand from outlet and allow air to flow.
  - Note pressure when low-pressure warning alarm sounds; it should be between 550-650 psi.
  - Remove hand from regulator outlet.
  - Close mainline valve.
    - Check regulator for leaks by blowing air into regulator for 5-10 seconds. Draw air from outlet for 5-10 seconds. If a positive pressure or vacuum cannot be maintained there is a leak. DO NOT USE SCBA.
5. Facepiece and corrugated breathing hose:
- Inspect hand harness and facepiece for damage, serrations, and deteriorated rubber.
  - Inspect lens for damage and proper seal in facepiece. Inspect exhalation valve for damage and dirt build-up.
  - Stretch breathing hose and carefully inspect for holes and deterioration.
  - Inspect connector for damage and presence of washer.
  - Perform negative pressure test with facepiece donned.
  - Tightly connect high pressure hose to cylinder.
  - Bleed pressure from high pressure hose by opening mainline valve.
  - Close by-pass valve.
  - Close mainline valve.

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- Fully extend all straps.
- Store facepiece in a clean plastic bag for protection.

**APPENDIX C:**

**CONFINED SPACE ENTRY PROCEDURES**

A confined space provides the potential for unusually high concentrations of contaminants, explosive atmospheres, limited visibility, and restricted movement. This section will establish requirements for safe entry into, continued work in, and safe exit from confined spaces. Additional information regarding confined space entry can be found in 29 CFR 1926.21, 29 CFR 1910 and NIOSH80-106.

## DEFINITIONS

*Confined Space:* A space or work area not designed or intended for normal human occupancy, having limited means of egress and poor natural ventilation; and/or any structure, including buildings or rooms, which have limited means of egress.

*Confined Space Entry Permit (CSEP):* A document to be indicated by the supervisor of personnel who are to enter into or work in a confined space. The Confined Space Entry Permit (CSEP) will be completed by the personnel who will be permitted to enter the confined space. The CSEP shall be valid only for the performance of the work identified and for the location and time specified. The beginning of a new shift with change of personnel will require the issuance of a new CSEP.

*Confined Space Observer:* An individual assigned to monitor the activities of personnel working within a confined space. The confined space observer monitors and provides external assistance to those inside the confined space. The confined space observer summons rescue personnel in the event of emergency and assists the rescue team.

## GENERAL PROVISIONS

- When possible, confined spaces should be identified with a posted sign which reads: Caution - Confined Space.
- Only personnel trained and knowledgeable of the requirements of these Confined Space Entry Procedures will be authorized to enter a confined space or be a confined space observer.
- A Confined Space Entry Permit (CSEP) must be issued prior to the performance of any work within a confined space. The CSEP will become a part of the permanent and official record of the site.
- Natural ventilation shall be provided for the confined space prior to initial entry and for the duration of the CSEP. Positive/forced mechanical ventilation may be required. However, care should be taken to not spread contamination outside of the enclosed area.



- If flammable liquids may be contained within the confined space, explosion proof equipment will be used. All equipment shall be positively grounded.
- The contents of any confined space shall, where necessary, be removed prior to entry. All sources of ignition must be removed prior to entry.
- Hand tools used in confined spaces shall be in good repair, explosion proof and spark proof, and selected according to intended use. Where possible, pneumatic power tools are to be used.
- Compressed gas cylinders, except cylinders used for self-contained breathing apparatus, shall not be taken into confined spaces. Gas hoses shall be removed from the space and the supply turned off at the cylinder valve when personnel exit from the confined space.
- If a confined space requires respiratory equipment or where rescue may be difficult, safety belts, body harnesses, and lifelines will be used. The outside observer shall be provided with the same equipment as those working within the confined space.
- A ladder is required in all confined spaces deeper than the employee's shoulders. The ladder shall be secured and not removed until all employees have exited the space.
- Only self-contained breathing apparatus or NIOSH approved airline respirators equipped with a 5-minute emergency air supply (egress bottle) shall be used in untested confined spaces or in any confined space with conditions determined immediately dangerous to life and health.
- Where air-moving equipment is used to provide ventilation, chemicals shall be removed from the vicinity to prevent introduction into the confined space.
- Vehicles shall not be left running near confined space work or near air-moving equipment being used for confined space ventilation.
- Smoking in confined spaces will be prohibited at all times.
- Any deviation from these Confined Space Entry Procedures requires the prior permission of the On-Scene Coordinator.

## **PROCEDURE FOR CONFINED SPACE ENTRY**

The HSO and Entry Team shall:

- Evaluate the job to be done and identify the potential hazards before a job in a confined space is scheduled.
- Ensure that all process piping, mechanical and electrical equipment, etc. have been disconnected, purged, blanked-off or locked and tagged as necessary.
- If possible, ensure removal of any standing fluids that may produce toxic or air displacing gases, vapors, or dust.

- Initiate a Confined Space Entry Permit (CSEP) in concurrence with the project manager or designated alternative.
- Ensure that any hot work (welding, burning, open flames, or spark producing operation) that is to be performed in the confined space has been approved by the project manager and is indicated on the CSEP.
- Ensure that the space is ventilated before starting work in the confined space and for the duration of the time that the work is to be performed in the space.
- Ensure that the personnel who enter the confined space and the confined space observer helper are familiar with the contents and requirements of this instruction.
- Ensure remote atmospheric testing of the confined space prior to employee entry and before validation/revalidation of a CSEP to ensure the following:
  - a. Oxygen content between 19.5% - 23.0%
  - b. No concentration of combustible gas in the space. Sampling will be done throughout the confined space and specifically at the lowest point in the space.
  - c. The absence of other atmospheric contaminants, if the space has contained toxic, corrosive, or irritant material.
  - d. If remote testing is not possible, Level B PPE is required as referenced in the health and safety plan.
- Designate whether hot or cold work will be allowed. If all tests in a through c are satisfactory, complete the CSEP listing any safety precautions, protective equipment, or other requirements.
- Ensure that a copy of the CSEP is posted at the work site, a copy is filed with the project supervisor, and a copy is furnished to the project manager.

The CSEP shall be considered void if work in the confined space does not start within one hour after the tests in a through c above are performed or if significant changes within the confined space atmosphere or job scope occurs.

The CSEP posted at the work site shall be removed at the completion of the job or the end of the shift, whichever is first.

## **CONFINED SPACE OBSERVER**

- While personnel are inside the confined space, a confined space observer will monitor the activities and provide external assistance to those in the space. The observer will have no other duties which may take his attention away from the work or require him to leave the vicinity of the confined space at any time while personnel are in the space.
- The confined space observer shall maintain at least voice contact with all personnel in the confined space. Visual contact is preferred, if possible.

- The observer shall be instructed by his supervisor in the method for contacting rescue personnel in the event of an emergency.
- If irregularities within the space are detected by the observer, personnel within the space will be ordered to exit.
- In the event of an emergency, the observer must NEVER enter the confined space prior to contacting and receiving assistance from a helper. Prior to this time, he should attempt to remove personnel with the lifeline and to perform all other rescue functions from outside the space.
- A helper shall be designated to provide assistance to the confined space observer in case the observer must enter the confined space to retrieve personnel.

**APPENDIX D:**

**SPILL CONTAINMENT PROGRAM**

The procedures defined in this section comprise the spill containment program in place for activities at the site.

All drums and containers used during the clean-up shall meet the appropriate DOT, OSHA and EPA regulations for the waste that they will contain.

Drums and containers shall be inspected and their integrity assured prior to being moved. Drums or containers that cannot be inspected before being moved because of storage conditions, shall be positioned in an accessible location and inspected prior to further handling.

Operations onsite will be organized so as to minimize the amount of drum or container movement.

Employees involved in the drum or container operations shall be warned of the hazards associated with the containers.

Where spills, leaks, or ruptures may occur, adequate quantities of spill containment equipment will be stationed in the immediate area. The spill containment program must be sufficient to contain and isolate the entire volume of hazardous substances being transferred.

Drums or containers that cannot be moved without failure shall be emptied into a sound container.